THE FOUNDRY

Vol. 44 No. 10 Whole No. 290

Cleveland, Ohio, October 1916

Great Foundry Convention Arouses Enthusiasm

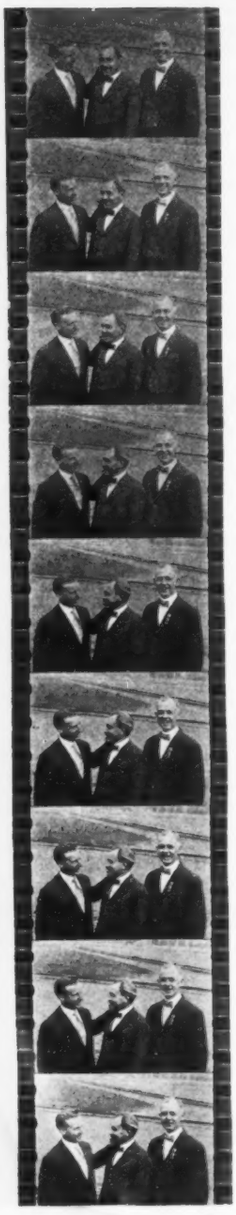
Results Flowing from Big Cleveland Meeting will be of Definite Benefit to the Casting Industry—Program Well Balanced—Discussions Spirited

IF THE proceedings of the 1916 annual joint convention of the American Foundrymen's Association and the American Institute of Metals, which was held in Cleveland Sept. 11 to 15, be reviewed and contrasted with a meeting such as that held in Pittsburgh only five years ago, it is clearly evident that the problems confronting the foundry business are rapidly growing more complex. At the meeting this year not only was the entire field of foundry operations brilliantly illuminated, but the outposts in the march of progress were thrown into bold relief, just as the principal surges in a midnight infantry attack are clearly delineated by the explosion of a number of well-placed star bombs. The flood of light resulting from the discussions accompanying the 72 papers and reports presented during the week indicated that it is no longer sufficient to consider merely the strictly technical problems of molding and casting. As the industry advances out of the chrysalis stage, ability to make simple castings successfully is taken for granted, and it becomes necessary to marshall all of the forces at hand for a successful attack on fresh difficulties only recently created by modern conditions. Among these, commercial problems relating to costs and the training of apprentices have assumed unusual importance, while at the same time the insistent demand for satisfactory shock-resisting castings from patterns of intricate shape, has compelled extensive researches into the borderland of metallurgy.

J. P. PERO,
Superintendent, Missouri Malleable Iron Co., East St. Louis, Ill., Recently Elected President of the American Foundrymen's Association, Incorporated

It is fortunate that as the fundamental problems of the industry grow more complex, the machinery offered by the allied foundry organizations for dealing with the difficulties as they arise is constantly becoming more efficient. The increasing effectiveness of the work of both the American Foundrymen's Association and the American Institute of Metals was clearly evident at the recent meeting in Cleveland. At no previous meeting were the exhibition, entertainment and technical features so thoroughly welded into a complete whole. The program was almost perfectly balanced, not only in its major, but in its minor elements. The topics presented at the professional sessions were so carefully selected and grouped that at no time did the interest flag or the attendance wane. The list of papers and reports was exceptionally long and the discussions were unusually extended, nevertheless the meetings were run off virtually on schedule time, leaving all of the afternoons free for the enjoyment of the entertainment features of the program, for plant visitation or the transaction of personal business. In spite of the unusual difficulties resulting from traffic delays, the exhibition was complete to the last detail, at the opening hour on Tuesday morning. A comprehensive description of the show appears in another part of this issue. Throughout the week, the attendance was phenomenal and the steady flow of visitors continued until the doors were closed Saturday evening. This year, for the first time, the exhibition feature was

THE LADIES COMMITTEE WAS EARLY ON THE JOB



A Strip of Greetings

operated under joint control of the American Foundrymen's Association and the American Institute of Metals, and there is every evidence that this method of cooperative management will meet with pronounced success. As in previous years, the active direction of the exhibition was entrusted to C. E. Hoyt, Lewis Institute building, Chicago.

The Cleveland committee, organized by the Cleveland Foundrymen's Association, entertained the visiting foundrymen in an unusually satisfying manner. The program, which included outdoor and indoor recreation features, was run off without a hitch. The final event of the week, the annual subscription banquet, was replete with unique features, excellent addresses and classical music.

The attendance was unusually gratifying. During the week 889 members and members' representatives, together with 194 ladies, were registered by the American Foundrymen's Association. The registration at the headquarters of the American Institute of Metals included 148 members and guests and 26 ladies. The total registration, therefore, reached the unprecedented figure of 1,257.

Opening Session

The address of welcome at the opening session, Monday afternoon, was delivered by L. T. Beman, director of public welfare, Cleveland, who represented the mayor. This address was followed by a response from Past President Alfred E. Howell, who spoke on behalf of the two associations.

The report of A. O. Backert, secretary-treasurer, showed that the total paid membership on July 1, 1916, was 918, as compared with 973 on July 31, 1915. The loss of 55 members during the year was due to the dropping of a large number of delinquent members, many of whom were taken into the association at the time the entire membership of the Associated Foundry Foremen was transferred to the American Foundrymen's Association in 1915. Since July 1, of this year, the membership has been increasing rapidly, and on Sept. 11 numbered about 980. On Sept. 15 the membership exceeded 1,000 for the first time in the history of the association.

The secretary-treasurer's report also showed the association to be in an exceedingly satisfactory condition financially. Total receipts during the year were $11,022.55, and total disbursements $11,934.83, thus making the apparent excess of disbursements over receipts $912.28. As a matter of fact, however, a considerable portion of the disbursements consisted of advances to the exhibition account; the revenue derived from the exhibition brought the association's cash balance on Sept. 11 up to the unprecedented amount of approximately $16,000.

The annual address of R. A. Bull, retiring president of the A. F. A., dealt almost exclusively with the steps leading up to the absorption of the exhibition feature and the incorporation of the American Foundrymen's Association.

A Novel Suggestion

Jesse L. Jones, president of the American Institute of Metals, in his annual address directed the attention of the joint meeting to the recent proposed amalgamation in Great Britain of various technical and engineering societies. He suggested that steps be taken to organize a similar amalgamation of engineering and kindred societies in this country, the work now being carried on by various separate associations to be apportioned among duly appointed sections of the proposed larger association.

Convention committees were appointed at the opening session to report, as usual, later in the week. The nominating committee was comprised of the following: Chairman, Alfred E. Howell, Phillips & Buttorff Mfg. Co., Nashville, Tenn.; J. S. Seaman, Seaman-Sleeth Co., Pittsburgh; J. D. Miles, Buffalo Foundry & Machine Co., Buffalo; S. D. Sleeth, Westinghouse Air Brake Co., Wilmerding, Pa., and C. H. Gale, Pressed Steel Car Co., Pittsburgh. The resolutions committee was appointed as follows: Chairman, S. B. Chadsey, Massey-Harris Co., Ltd., Toronto; V. E. Minnich, Sand Mixing Machine Co., New York, and W. B. Robinson, *Iron Age*, Pittsburgh.

The second joint session of the two organizations was called to order Tuesday morning by R. A. Bull, president of the American Foundrymen's Association. A symposium on the results of closer cooperation between the engineer and the foundry was the first subject for the consideration of the 200 foundrymen who attended the meeting. The symposium covered all fields of the foundry industry, and papers dealing with the subject as it applies to gray iron, steel, malleable and non-ferrous metal foundries were prepared by D. W. Sowers, Sowers Mfg. Co., Buffalo, N. Y.; John Howe Hall, Taylor-Wharton Iron & Steel Co., High Bridge, N. J.; G. F. Meehan, Ross-Meehan Foundries, Chattanooga, Tenn., and C. E. Chase, Mojeski & Angier, Chicago.

Each speaker emphasized the need of closer cooperation, and pointed out the apparent weaknesses of the present practice. It was the consensus of opinion that the engineer should give more consideration to the foundryman, and that the foundryman should always attempt to make better castings. Several of the authors touched upon the confusion caused by the improper use of the terms elastic limit and yield point, and it was suggested that the term "yield point should be left to those metals fortunate enough to possess it and some other term adopted for the rest".

In the ensuing discussion Dr. Richard Moldenke said that the engineer is becoming an important factor in the foundry, and that it might be best "to take him into the family" as soon as possible. He expressed the opinion that standard test bars present a better method of studying cast metal than coupons from the castings. Commenting upon the relations between engineers and foundrymen, G. Rottweiler, Davis Sewing Machine Co., Dayton, O., claimed that many engineers were obstinate in their demands for certain features of castings. The solution of present difficulties lies in the concessions that must be made by each side in the controversy. During the discussion, it was suggested that American specifications should be made standard for international use. Other speakers claimed that this is impossible and asserted that international specifications compiled from the best in each of many national specifications, would be the most satisfactory and practical code of this kind.

The Gating of Castings

A symposium on the influence of gating on castings was presented by Benjamin D. Fuller, Westinghouse Electric & Mfg. Co., Cleveland; A. M. Fulton, Fort Pitt Malleable Iron Co., Pittsburgh, and R. R. Clarke, Pennsylvania Railroad Co., Pittsburgh. A contribution entitled "Gating Steel Castings", by W. J. Gilmore, Hubbard Steel Foundry Co., East Chicago, Ind., was also included in the symposium. Each speaker clearly brought out the fact that there is an intimate relation between the location of the gate and the shrinkage problem. Russell R. Clark, whose discussion of gating problems in connection with non-ferrous castings was termed "an oration" by Dr. Moldenke, exhibited a number of castings to show that proper gating is important on account of the difficulties resulting from oxidation of the metal and the comparatively low temperature at which the metal freezes after being cast in the mold.

NOT WAITING AT THE CHURCH BUT HOPING FOR THE BUS

In a paper discussing the practicability of reclaiming waste foundry sand, H. B. Swan, Cadillac Motor Car Co., Detroit, mentioned a foundry in which it is claimed that it is absolutely possible, "at a very nominal expense, to take refuse sand and convert it back to a condition fit for use. In fact, it is almost impossible to tell the old from the new." This paper aroused considerable interest as was manifested by the discussion which followed.

Artificial Molding Sand

Dr. Moldenke was of the opinion that inasmuch as from four to 16 tons of sand are used for every ton of finished castings, the subject of reclamation is an important one. He suggested that the finishing of the mold without the use of sea-coal should be studied. He also expressed the opinion that the foundry industry is nearing the time when artificial sand will come into general use, and he urged the American Foundrymen's Association to take up this subject for investigation. A number of speakers discussed the paper of Mr. Swan, and cited instances of successful reclamation of sand.

In the absence of S. W. Stratton, director, United States bureau of standards, C. P. Karr, assistant physicist, bureau of mines, gave a brief report covering what the federal government has been doing to prepare an artificial molding sand. Mr. Karr asked honest criticism on his opinion that 2900 degrees Fahr. represents the melting point of good molding sand. He also mentioned efforts that are to be made to standardize the classification of various grades of molding sand so that the confusion now caused by several series of numbers may be avoided. As a result of this report, and in accordance with views expressed in the subsequent discussion, it was decided that the American Foundrymen's Association cooperate with the bureau of mines on the reclamation of waste foundry sand.

America's Fire Waste

In one of the most masterful addresses of the convention, Franklin H. Wentworth, secretary of the National Fire Protection Association, Boston, strongly emphasized the seriousness of America's indifference to losses by fire. He compared conditions in Europe and America, showing that across the Atlantic the man who owns property that takes fire, is considered an enemy of the community, whereas in this country, the public sympathizes with the man whose property is is destroyed or damaged by fire. Metal sash and wire

The A. F. A. Feature Film

MEMBERS OF THE AMERICAN FOUNDRYMEN'S ASSOCIATION AND AMERICAN INSTITUTE OF

glass windows were named as effective preventatives of destructive conflagrations. Mr. Wentworth implored the foundrymen to do their share in educating the public up to the point where it will realize the real waste incurred by fires. As a result of the address, the committee on safety and sanitation was empowered to study the subject of fire protection and prevention.

John A. Rathbone spoke briefly on what Pratt Institute is doing to train men for the foundry industry. Papers covering the relations of trade and technical schools to the foundry industry had been prepared by Samuel S. Edmands, Pratt Institute, Brooklyn, N. Y., and John Grenman, University of Nebraska, Lincoln, Neb. The paper on "Reducing Foundry Costs by Analysis", by R. E. Kennedy, University of Illinois, Urbana, Ill., was read by title.

Wednesday General Session

The Wednesday morning session was devoted entirely to the reading of reports of committees and the presentation and discussion of several technical papers. In the report of the American Foundrymen's Association committee on foundry costs, which was read by Benjamin D. Fuller, Westinghouse Electric & Mfg. Co., Cleveland, it is recommended that an arrangement with a reliable cost accounting firm be considered. It was also pointed out that the federal trade commission is developing cost accounting systems for various industries. A. O. Backert, secretary of the association, explained what E. N. Hurley, chief of the commission, is doing to develop cost accounting systems for manufacturers.

C. H. Scovell, Clinton H. Scovell & Co., Boston, emphasized the necessity for good cost accounting. He said that foundrymen must develop this feature in their business until their systems are so standardized that all may compete on a common basis. Mr. Scovell's talk was followed by an enthusiastic discussion, in which difficulties now encountered on account of the lack of a uniform cost system were enumerated and suggestions for action offered. The secretary introduced a motion to the effect that the committee on foundry costs be empowered to investigate the best method of carrying out the suggestions of previous cost committees, and that the board of directors be empowered to put the plan in action, if deemed advisable. This motion was carried.

Faults of Profit-Sharing

An interesting discussion on profit-sharing was contributed by C. E. Knoeppel, C. E. Knoeppel & Co., New York. Mr. Knoeppel declared that saving-sharing plans had failed in most cases because labor does not understand the motives, because the plans have not been based upon individual attainment, because the reward in many cases is so far in the future that the workman loses interest in the plan, and finally, because manu-

Fill Holes With Scrap

Alfred E. Howell, a past president of the A. F. A., entertained the members at the Friday morning session with an interesting outline of his 35 years' experience in a gray iron foundry.

"My superior," said Mr. Howell, "once instructed me to use as much scrap as possible so that this small-grained material would fill up the interstices of the big-grained pig iron. When one reflects that such opinions were once common, a clearer insight is gained into the wonderful strides the foundry industry has made."

"Another old-time fallacy," continued Mr. Howell, "was the belief that the tuyeres in a cupola should be as small as possible so that the air blast would be fiercer and the air would thus reach the center of the cupola. One day while overhauling the cupola in the absence of my superior, I had the tuyeres made larger only to have the superintendent return and order them reduced to their former size. Modern practice, of course, teaches us how mistaken this belief was."

METALS TARRIED A MOMENT BEFORE THE BALL GAME TO POSE FOR THEIR PHOTOGRAPH

facturers have been unfair in dealing with their employes. In the discussion, one speaker declared that employers as a whole are trying to pay as low wages as possible, whereas, in his opinion, the highest possible wage should be the object of their efforts. Another speaker thought that insincerity was the cause for many failures of profit-sharing, while Dr. Moldenke said that all trouble of this kind can be laid to injustice.

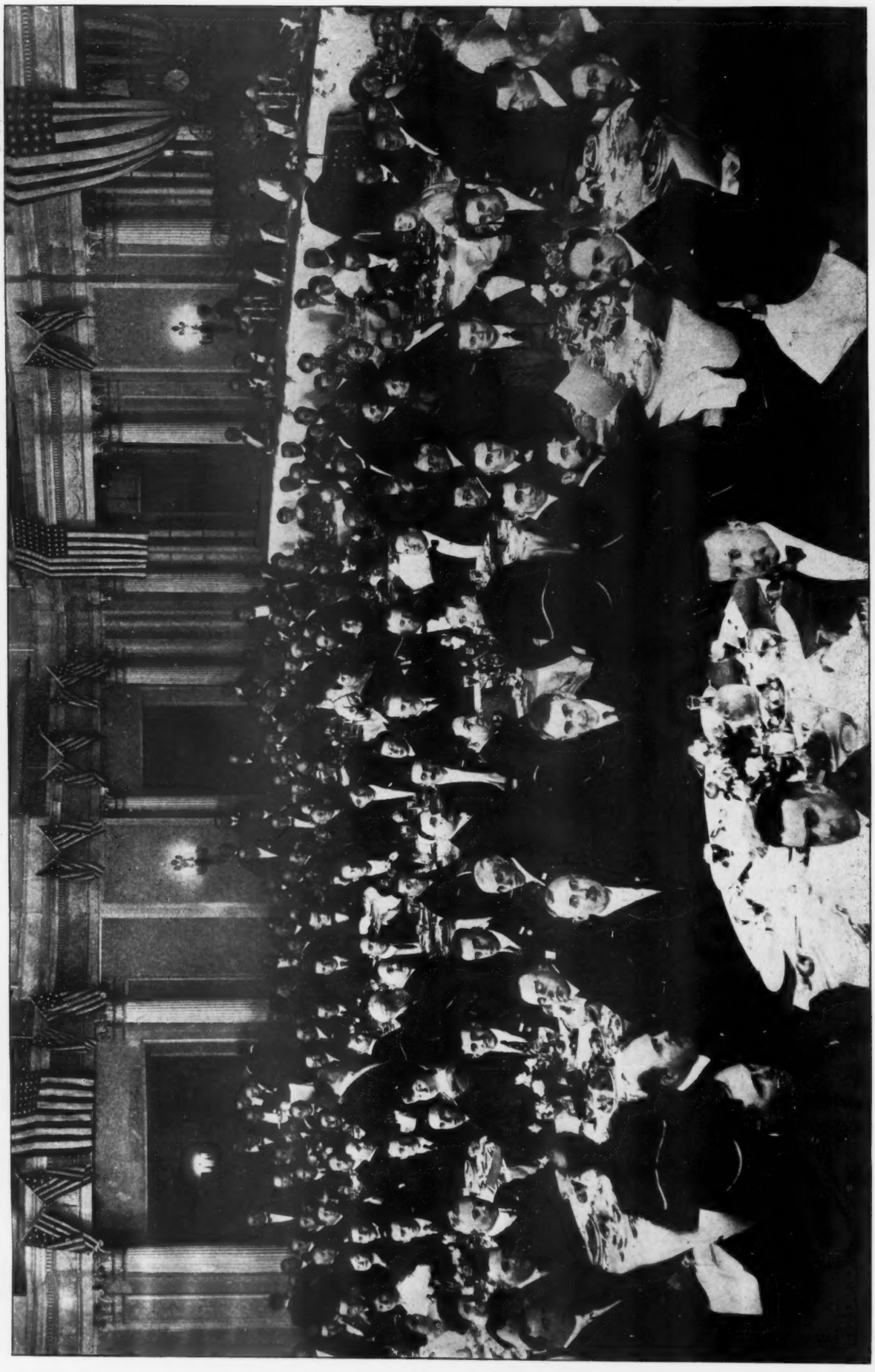
Scrap Specification Adopted

G. E. Jones, Whiting Foundry Equipment Co., Harvey, Ill., gave the report of the committee on foundry scrap. After some discussion as to what action should be taken in regard to the recommendations of the committee, it was decided to adopt the specifications.

The reading of the report of the representatives on the conference board on the training of apprentices, by Benjamin D. Fuller, Westinghouse Electric & Mfg. Co., Cleveland, was the signal for a prolonged exchange of ideas regarding the training of apprentices and the functions of trade and technical schools. A. H. Kramer, Advance Foundry Co., Dayton, O., asserted that the practice of "stealing" an apprentice as soon as he had been trained is discouraging foundrymen from carefully training young men for the foundry trade. C. B. Connelley, dean of the school of applied industries, Carnegie Institute of Technology, Pittsburgh, said that a good system of apprenticeship would solve the problems of labor, cost accounting, etc., now confronting foundrymen. In replying to Mr. Kramer, he said that if the proper attitude between employer and employe existed, there would be no "stealing" of apprentices. Dean Connelley outlined the function of a technical school, and later, in reply to a speaker who had claimed that the foundry trade was discredited and the molder despised, said that in any line of work, "it is what you make of the job, and not how you dress for it, that counts". G. Rottweiler, Davis Sewing Machine Co., Dayton, O., enthusiastically described the apprentice system of Germany which he maintained turned out perfect all-around molders. J. P. Pero, Missouri Malleable Iron Co., East St. Louis, Ill., said that the foundrymen had "sowed the wind" and now were "reaping the whirlwind". He declared that many executives were guilty of placing apprentices where they would best benefit the company, and that in many cases this meant that their training was directed along specialized lines. Mr. Pero also referred to the growing tendency to do away with the all-around molder on account of the changed system of foundry management, which requires that each man specialize on one particular operation. J. H. Wilson briefly explained what the American Rolling Mill Co., Middletown, O., is doing to train apprentices, and asked what other firms had done in this respect. It was finally decided that the com-

The New President

J. P. Pero, president of the American Foundrymen's Association, has been actively associated with foundrymen's organizations for over 30 years. In 1887 he created the New England Foremen's Association and in 1909 he organized the St. Louis association. Mr. Pero was born in Massachusetts in 1856, though his youthful spirit and great energy belie the fact. At 14 he entered upon his apprenticeship in a gray iron foundry at Worcester, Mass., and in 1875 he began as a journeyman in the employ of the Chapman Valve Co. He served as foreman in various foundries in New England and in 1888 he became associated with malleable work, accepting the position he now holds with the Missouri Malleable Iron Co. in 1909. Mr. Pero was elected vice president of the American Foundrymen's Association in 1914 at the Chicago convention, and became senior vice president at the Atlantic City meeting in 1915.



THE BANQUET STARTED ON TIME BUT THE PROGRAM PROVED SO ENTERTAINING THAT THE GUESTS TARRIED LATE

mittee should study various apprentice systems, and that the board of directors be empowered to draft a contract for apprentices, if in its opinion, such action is considered advisable.

Dr. Richard Moldenke gave the report of the advisory committee to the United States bureau of standards. He recommended that foundrymen work for the preparation of a "fool-proof" molding sand, that a sieve scale be adopted and that the numbers by which various grades of sand are now distinguished be standardized. A motion was carried to the effect that the board of directors be empowered to adopt the sieve scale recommended by the bureau of standards and to standardize the numbering of molding sands.

Victor T. Noonan, industrial commission of Ohio, Columbus, O., presented the report of the committee on safety and sanitation. He said that the code prepared by the committee was, in his estimation, the best that had been drafted by any organization. In discussing the subject of industrial accidents, he declared that safety rules are not enforced, and that the lack of discipline in this respect is responsible for many of the accidents that occur. A resolution, urging the governors of the various states to use their influence to have laws enacted which will place part of the responsibility for accidents upon the workmen, was presented. It was decided that a committee consisting of H. D. Mills, Buffalo Foundry & Machine Co., Buffalo, N. Y., and J. P. Pero, Missouri Malleable Iron Co., confer with a committee from the National Foundries' Association to modify the safety code if advisable and that the board of directors adopt this revised code if it is deemed satisfactory by members of the board. A. E. Howell, chairman of the nominating committee, read the list of nominees, which included the names of the directors in office at that time, with the exception of A. H. Thomas and Walter Wood, whose names were replaced by S. G. Flagg 3rd, Stanley G. Flagg & Co., Philadelphia, and S. B. Chadsey, Massey-Harris Co., Toronto, Ont. The secretary was empowered to cast an unanimous ballot, electing the 16 directors.

Steel Session

The unusually large attendance at the Thursday steel session was undoubtedly attracted by the promise of a lively discussion over the merits of various methods of making steel for castings. After a brief introductory talk by W. A. Janssen, chairman of the session, Carl H. Booth, Snyder Electric Furnace Co., Chicago, discussed "The Ideal Electric Furnace in the Steel Foundry", a paper prepared by F. J. Ryan, E. B. McKee and W. D. Walker, of the Snyder company, as part of a symposium on electric furnace practice. Mr. Booth presented the single-electrode type of furnace as the ideal. He described an open-roof type of furnace, and offered statistics, showing the performance of a number of single-electrode furnaces in the United States and Canada. Eugene B. Clark, Buchanan Electric Steel Co., Buchanan, Mich., briefly described the four processes of making steel and stated that the advantage of the electric furnace over other melting mediums is in its ability to produce a higher quality of steel. He strongly emphasized the fact that the electric furnace is not a cure-all for foundry evils, but that it requires care and attention in operation. Joseph L. Dixon, John A. Crowley Co., Detroit, described a Gronwall-Dixon furnace installed and in operation at Detroit. The paper on this subject, by John A. Crowley, appears in this issue. The furnace operates on a 2-phase system, energy being taken from 3-phase supply through two banks of transformers, which deliver current at varying voltages through two or four-roof electrodes and one bottom electrode. The arcs may be thrown in series or parallel and the furnace may be operated in intermediate positions between series and parallel. The representative of a foundry using open-hearth furnaces placed the electric furnace people on the offensive when he claimed that the converter and open-hearth furnace men wanted to be shown why they should throw away their existing equipment in favor of the electric furnace. Mr. Clark brought out the point that the supervision of foundries was becoming more efficient on account of the fact that better trained men were required to direct the operation of electric furnaces, and that their influence is being extended to practically all departments of the foundry. One speaker asked what had been done to meet the A. S. T. M. requirements for steel castings. He wanted to know where he could buy castings to meet those specifications. Chairman Janssen suggested that this was evidently a good chance for some of the salesmen for steel foundries to get some business, but there was no reply to the inquiry.

T. S. Quinn, Lebanon Steel Foundry, Lebanon, Pa., described the results obtained with a 1-ton heroult furnace during a period of 18 months. He touched on a number of points previously discussed in other papers, when he said:

"Today the development of the electric furnace is hampered, if not threatened, by instances of dissatisfaction with the product, probably because it is the trend of the times to commercialize any important discovery on a large scale, and it is possible that the exploitation and installation of electric furnaces has been so rapid that the development of metallurgical and operative skill has not been in proportion. Certainly the electric furnace does not call for any better operative talent than the open hearth, and it is only reasonable to assume that when electric furnace practice is established and standardized as has been the case with the open hearth, it will come into its own."

M. G. Tielke, Crucible Steel Casting Co., Cleveland, mentioned a heroult furnace operating under practically the same conditions as that described by Mr. Quinn, but with an adequate supply of power, which consumed a much lower number of kilowatt-hours per ton of steel. E. L. Crosby, Detroit Edison Co., Detroit, also emphasized the importance of having sufficient transformer capacity to operate furnaces economically. He

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said that good power station service depends largely upon the cooperation of the producer and consumer of power. Peter Blackwood, Blackwood Steel Foundry Co., Springfield, O., compared electric and converter steel in a paper which was given unusually close attention. Mr. Blackwood made the statement that under ordinary conditions a 1-ton baby converter can successfully compete with a 6-ton electric furnace. His comparisons between converter and electric steel were for the most part favorable to the former.

"The Presence of Alumina in Steel" was the subject of an interesting paper presented by G. F. Comstock, Titanium Alloy Mfg. Co., Niagara Falls, N. Y. Mr. Comstock showed a number of microphotographs on the screen, in which the presence of the various inclusions was clearly indicated.

A paper on the manufacture of manganese steel castings was prepared by W. S. McKee, American Manganese Steel Co., Chicago.

Friday Steel Session

At the Friday morning steel session, John Howe Hall, Taylor-Wharton Iron & Steel Co., High Bridge, N. J., presented the report of the committee on specifications for steel castings. Mr. Hall mentioned the results of a conference held with representatives of the Steel Founders' Society and the American Society for Testing Materials. The report was accepted and is to be made part of the transactions of the association.

W. A. Janssen, Bettendorf Co., Davenport, Ia., presented a paper entitled "The Use of Titanium in the Manufacture of Steel Castings". N. Petinot, consulting engineer, New York, in a letter read at the meeting, took exception to several points raised by Mr. Janssen. The chief points of difference seemed to be in the merits of vanadium, titanium and other alloys as deoxidizers. L. Selmi, Corrigan, McKinney & Co., Cleveland, related his experiences with over 100 heats of acid open-hearth steel untreated and treated with the Goldschmidt alloy, aluminum and ferrotitanium.

Edwin F. Cone, *The Iron Age*, New York, delivered a paper comparing acid with basic steel for castings. He said that there is a distinct dividing line between acid and basic castings. Castings which must be machined all over are almost universally made of acid open-hearth steel and practically all other castings, particularly for railroad cars, are poured from basic steel. Mr. Cone described a method of producing basic castings from acid scrap and showed by statistics the relative production of basic and acid castings in the United States and Germany. R. A. Bull, Commonwealth Steel Co., Granite City, Ill., contributed a written discussion, in which he showed that manufacturers in the east have been slow to discard acid steel, but that in the west the results from continued use of basic have justified the action of manufacturers who have placed their faith in it. John McEwen, McEwen Mfg. Co., Tulsa, Okla., asked if basic steel can satisfactorily be used in the manufacture of hydraulic machinery. Mr. Bull replied that he thought that basic steel could be used for this purpose, and Mr. Janssen declared that the Bettendorf company has been successfully making hydraulic machinery from basic castings for several years. Mr. Janssen was of the opinion that ordinarily basic steel is cheaper than acid steel, but for castings of equal quality, the spread in prices between the two kinds of steel is diminished. Mr. Cone asked why acid operators do not change to basic if the process is more desirable. Mr. Janssen replied that the manufacture of basic castings requires better supervision, and that the east has been obliged to come to the west for basic operators.

Ralph D. West, West Steel Casting Co., Cleveland, presented an exhaustive paper on the theory and practice of gating and heading steel castings. He explained the relation between gating and heading and the shrinkage of castings and warned foundrymen against the practice of allowing molders to use their own judgment in gating castings. Mr. West described how certain representative castings should be gated and headed, and urged the foundrymen of today to adopt the practice of more freely exchanging ideas so that "we may be able to develop a theory in relation to our practice."

David Evans, Chicago Steel Foundry Co., Chicago, was not present to read his paper on alloy steel castings, and Frank Carter, Milwaukee, Wis., who had prepared a paper on "The Small Open-Hearth as a Flexible Unit for Either Large Steel Foundries or General Jobbing Shops", was not in attendance.

Malleable Session

On Thursday morning, malleable iron foundrymen held a special session and discussed problems peculiar to this important branch of the castings industry. J. P. Pero, Missouri Malleable Iron Co., East St. Louis, Ill., the newly elected president of the American Foundrymen's Association, presided at the meeting. Mr. Pero opened the session by vigorously commending the malleable foundrymen for their evident interest in the proceedings. He pointed out that it was the third year that a separate session had been set apart for the discussion of malleable practice and that the attendance this year far exceeded that of the two preceding. At the conclusion of the session, Mr. Pero again congratulated those in attendance for their lively participation in the discussions and strongly urged upon malleable foundrymen the necessity of preparing papers for next year's convention, as an abundance of papers would insure the malleable industry a more prominent place in the convention proceedings.

Five separate papers and a special committee report were presented at this session. Frank J. Lanahan, Fort Pitt Malleable Iron Co., Pittsburgh, discussed "The Application of Malleable Iron Castings in Car Construction." He pointed out that one of the most important features entering into freight car construction is the character of the castings that are used to join individual sections. For this purpose, the author stated, malleable iron castings will generally prove their superiority for two important reasons, their greater length of service and their economy. Mr. Lanahan then urged closer cooperation between foundrymen and engineers in order that castings could be designed to give maximum strength. The combined efforts of leading malleable foundrymen, he stated, in the past few years have brought about a great improvement in the quality of malleable castings. The tensile strength and elongation have been increased materially, tensile bars now averaging from 48,000 to 53,000 pounds per square inch, with an elongation of 10 to 12 per cent. The elastic limit also is high.

Need of Cooperation

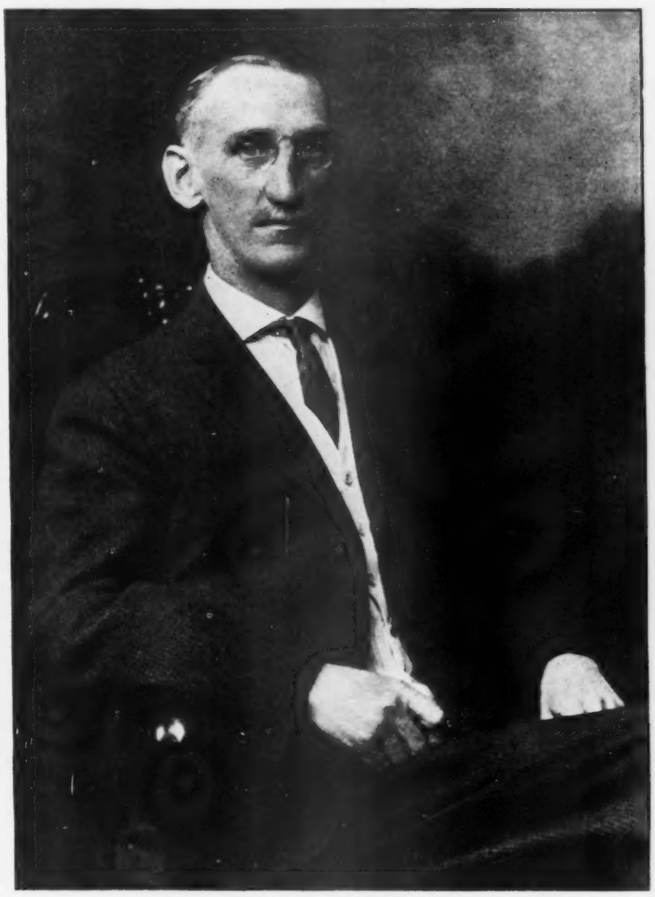
Mr. Lanahan's conclusions briefly stated the case of the malleable foundrymen as follows:

"Malleable iron has been misunderstood and frequently criticised in the past, partly on account of careless and incompetent manufacture, but largely too because of the customer's insufficient knowledge concerning it. During the past few years the industry has undergone a complete change and the process and practice today is far in advance of the haphazard system followed three or more years ago. As an illustration, each foundryman formerly had his own analysis for the raw materials, and the same idea governed the finished castings. Neither analysis was based on any scientific knowledge but simply what this or that individual thought was right. In contrast with such practice, the modern method is to follow a standard pig iron analysis, for a uniform result in the finished product, depending on the purpose for which the castings are to be used. The standards so set are the result of a long series of metallurgical, chemical, mechanical and other scientific tests. Customers can readily understand how

necessary it is for a manufacturer to know exactly where the castings are to be used, and under what conditions, so that he may determine what particular feature should be developed as the casting's strongest characteristic. Commendable solicitude on the part of the engineers in their effort to obtain minimum sections so as to reduce weight, and consequently cost, has in the past resulted in condemnation of the material when the real trouble was caused by insufficient metal. In this respect it is wise to follow good engineering practice, by figuring theoretically and designing practically, bearing in mind the extremely difficult service demanded at times, erring if at all, on the safe side by having ample metal thickness to meet the requirements."

The American Foundrymen's Association committee on standard specifications for malleable iron castings, through its chairman, Enrique Touceda, presented a short report. The committee had not had time to finish its work and requested permission to continue. This permission was readily granted. Enrique Touceda, Albany, N. Y., then presented his paper on "What is the Normal Fracture of Good Malleable Iron?" The author first calls attention to the difficulty of securing good test specimens. When test lugs are broken off in the usual manner, the fractures are made complex by virtue of the fact that failure occurs due to the influence of both tension and compression stresses, these being of varying intensity, depending upon their distance from the neutral axis. Prof. Touceda expresses the opinion that more accurate results would be obtained from a study of fractures that have been produced through a direct pull. He then points out that there is a difference in structure between the skin and core of a steel casting, as in a malleable casting, the difference, in the former case not being visible to the naked eye. When good malleable iron is broken in simple tension the grains become tapered down to a point, forming what is known as a tooth. This results in the fracture having a somewhat different appearance when viewed by oblique light than that which it exhibits when viewed in a direct light. These differences are fully explained. If a bar of malleable is broken transversely a silvery white area will appear on the compression side and the more ductile the metal, the greater will be the depth of this silvery area.

In response to a question raised by P. H. Davis, superintendent of the Moline Malleable Iron Co., St. Charles, Ill., Prof. Touceda pointed out that in elongation tests on malleable bars, the core breaks first, indicating greater strength in the core than in the skin. Only when malleable iron is poor, is greater strength found in the skin. C. H. Gale, Pressed Steel Car Co., McKees Rocks, Pa., asked whether the carbonless rim in steel occurs in every kind of steel. Prof. Touceda stated that this rim exists in all forms of steel, such as rolled, forged and annealed specimens, but does not occur in unannealed cast steel. As such castings are practically always annealed, however, he stated this distinction is relatively unimportant.



BENJAMIN D. FULLER, VICE PRESIDENT, A. F. A., IS A REAL FOUNDRYMAN

"The 25-Ton Air Furnace" was discussed in a paper by F. C. Rutz, Rockford, Ill. This paper is presented in full in another part of this issue of *The Foundry*. The author presents details of a 25-ton air furnace designed for melting malleable iron and expresses the belief that this is the most satisfactory size for a number of reasons. The operating cost of the 25-ton furnace is estimated to be $3.25 per ton, compared with a cost of approximately $3.85 per ton for 12 and 15-ton furnaces. The melting ratio with the large furnace, covering a year's tonnage actually poured, is said to be 2.75 to 1. This furnace, it is claimed, will do practically double the work of a 12 or 15-ton furnace.

Chairman Pero asked whether the economy of space effected by the large furnace would not be more than offset by the greater distance to which the iron must be carried. He questioned whether the economies of the large furnace would not be matched by increased cost of labor, greater loss in hard iron and greater labor fatigue. Stanley G. Flagg 3rd, Philadelphia, in explaining the results of his operation of large furnaces stated that such difficulties had not been experienced, as the heavy work was placed at the greatest distance from the furnace and the small work nearest the furnace. In this manner hot iron was obtained for small work and cooler iron for the heavy work. In response to a query by another speaker concerning the possibility of a wider use of cranes in malleable foundries, Mr. Flagg stated that the crane equipment for the big furnaces was practically the same as for the small furnaces. A tramrail is used, he stated, to carry the bull ladle to the far end of the shop. The furnaces are charged by hand. Mr. Flagg suggested that two or three tap holes be employed in tapping the big furnaces, as bad iron can be avoided by first tapping the high tap hole. He stated that with good coke, three tons an hour can be melted down with the big furnace. A query as to the present practice of charging either on a cold furnace or after heating for an hour, developed that the latter method is now almost obsolete. Practically all malleable foundrymen now charge on a cold furnace.

W. G. Kranz, National Malleable Casting Co., Cleveland, described "The Commercial Side of the Malleable Iron Industry." After outlining the work of Reaumur and Boydon, he sketched the growth of the industry and the increasing application of malleable iron to various uses. Since 1900, production of malleable iron has increased about five times, or from 173,415 gross tons in 1900 to 993,736 gross tons in 1913.

Since the automobile industry began to make big demands on the malleable foundrymen, the consumers have begun to study malleable, the automobile engineer in particular, being on the search for a metal that would withstand shock. Common properties and uses of malleable are its resistance to corrosion; its adaptability for both light and heavy sections and its good magnetic qualities. Owing to its permeability, malleable iron is being more extensively used in the electrical industry. The future of malleable iron, stated Mr. Kranz, is bright as greater study by engineers will make known its suitability for uses in other lines of engineering endeavor.

Prof. Touceda in amplifying a statement in Mr. Kranz's paper that malleable iron is now being made with an elongation of 15 per cent, detailed the results of tests he had conducted in the last 10 months on from 7,000 to 8,000 bars. On these bars elongations of 19, 20 and 21 per cent were observed. His tests, he stated, showed that malleable iron has a property not encountered in most other metals, that is, that as the ultimate strength increases, the elongation increases. Bars of more than 52,000 pounds tensile strength had shown an elongation as high as 15.80 per cent.

A paper entitled "A Suggested Standard for Pattern Parts," by W. W. Carlson, Kansas State College, Manhattan, Kan., was presented. In this paper, the author points out that the principles of specialization and standardization can be applied in the pattern shop as well as in other parts of the foundry. He points out the advantage, for instance, of the molder knowing just what surfaces of the casting are to be finished and what surfaces or points must make a close fit. For this purpose the author suggests a system of coloring the various parts of the pattern. A set of standards for core prints is also described and illustrated.

Gray Iron Session

A special session for the discussion of problems of particular interest to manufacturers of gray iron castings was held on Friday morning. Nine papers were presented and three reports received from special committees. The lively interest taken in the proceedings was indicated by the discussions which each of the papers aroused.

G. S. Evans, Lenoir Car Works, Lenoir City, Tenn., presented a paper on "The Effects of Different Mixtures on the Strength of Chilled Car Wheels." He gives the results of a series of exhaustive tests of car wheel mixtures made at the Lenoir City plant. These tests extended over a period of two years and were undertaken to determine the relative strength of car wheels made from different mixtures but under uniform foundry conditions. During the tests, wheels were cast from 60 different mixtures, some carrying as much as 60 per cent scrap steel; others 85 per cent charcoal and coke pig iron, and others as much as 98.5 per cent scrap wheels. It was found that car wheels could be made from all these mixtures that would meet the requirements of the latest Master Car Builders' Association specifications. Over 15,000 wheels were cast from the special mixtures and over 1,000 tested to destruction. Mr. Evans concludes that no gain in strength is obtained by increasing the percentage of either charcoal or coke pig iron beyond approximately 12 per cent. Foundry practice, including the melting, casting and annealing, appears to be largely responsible for the ultimate strength of the finished wheels, and the greatest possible source of betterment of the output as a whole, results from the standardization of this practice. A number of tables are presented, giving test determination and numerous microphotographs are included.

Sulphur in Car Wheels

In response to a question by C. C. Kawin, Chas. C. Kawin Co., Chicago, Mr. Evans stated that at his foundry the sulphur content never exceeds 0.15 to 0.16 per cent. He also pointed out that high-silicon iron shows a sharp line of demarcation after chilling. Ferro-manganese and spiegeleisen are used in the same manner, whether charcoal or coke pig iron is being melted. These additions are made simply to bring the analysis to the desired point regardless of the original character of the iron. The ferro-manganese is usually added in the cupola and only infrequently in the ladle.

"Semi-Steel Classified," is discussed in a paper by David McLain, McLain's System, Milwaukee, in a paper which was illustrated by stereopticon views. Mr. McLain's paper points out that while semi-steel has not been recognized in iron and steel nomenclature, it ranks among the most valuable products of the gray iron foundry. The paper suggests that standard chemical specifications covering the different classes of castings should be clearly defined. "Our contention," says Mr. McLain, "always has been that no metal could be defined as semi-steel unless it contained from 25 to 50 per cent steel, and even the reputation of this metal has suffered to some extent from those who offer a product as semi-steel which is not even a good gray iron. Any man who thinks he can simply throw some steel scrap in with pig iron and make good semi-steel is very much mistaken." The author then discusses the history of semi-steel and thoroughly explains the metallurgy of this material. He gives in detail the uses of semi-steel. He discusses the hardening of semi-steel and claims that it has been used successfully for dies and punches. He does not believe, however, that semi-steel would replace tool steel. The discussion developed the great influence of coke in determining the quality of either pig iron or semi-steel.

Adopt Coke Specifications

The report of the American Foundrymen's Association committee on standard methods for analyzing coke was tentatively adopted. This committee, of which H. E. Diller, General Electric Co., Erie, Pa., is chairman, has been at work for some months in conjunction with committees representing the American Society for Testing Materials and the American Chemical Society. The three committees have agreed on standard specifications which had previously been tentatively adopted by the American Society for Testing Materials. The American Foundrymen's Association adopted methods for coke analysis in 1912 which are now superseded. The committee recommended that the peroxide method for the determination of sulphur should be given as an alternative method to the one offered.

"The Use of By-Product Coke in Foundries," is explained in a paper by George A. T. Long, Pickands, Brown & Co., Chicago. "The requisites of a good by-product foundry coke," says Mr. Long, "are first, high carbon; second, low sulphur; third, good cellular structure, and fourth, that the product shall be uniform. The carbon and sulphur are primarily the result of the quality of coal which is used in the ovens for coking purposes. The structure, however, depends on proper preparation of the coal before coking, as well as upon the arrangement of the ovens in which the coal is coked, and upon the temperature of the coking chamber."

Mr. Long in discussing the use of this fuel in cupolas states that for ordinary soft gray iron castings, the bed should be brought up to 24 inches above the tuyeres. Small charges are recommended. In ordinary cupolas of 24 to 36 inches inside diameter, 1,000 - pound charges are considered satisfactory. In cupolas from 36 to 54 inches, 2,000-pound charges are preferred. In larger cupolas 3,000 pounds is considered the limit. Mr. Long recommends that the blast pressure be kept as low as possible in order to avoid trouble from slag, hard iron, shrinkage, etc. He states his belief that it is not necessary to select large sized coke for the bed, as the large pieces leave too much space for the passage of the air. He con-

cludes by stating that a uniform fuel is the greatest asset a foundryman can have. Benjamin D. Fuller, Westinghouse Electric & Mfg. Co., Cleveland, who was chairman of the meeting, brought out the fact that by-product coke was now more uniform than a few years ago when its manufacture was less fully understood.

Using Borings in a Cupola

James A. Murphy, of the Hooven, Owens & Rentschler Co., Hamilton, O., described "The Use of Borings in Cupola Operations." In the absence of the author the paper was read by title only. In this paper the author points out that for many years iron borings and steel chips have been charged in cupolas to reduce the cost of the mixture and to better the quality of the metal. When borings or chips have been charged loose with pig iron and scrap, the melting loss is excessive and when charged alone, the heat does not penetrate the mass far enough to melt the entire charge. The practice of laying a bed of borings on the cupola bottom is said to be unsatisfactory as heat is wasted. It was accidentally discovered that by using lengths of stove pipe as containers, chips and borings could be charged in the cupola in such a way that the melting loss amounts to only 2 per cent. These stove-pipe cartridges hold about 50 pounds of borings and the cost of preparing them does not exceed $2.50 per ton. Walter F. Prince in 1908 introduced a method of melting chips in a vertical tube placed in one side of the cupola. Although satisfactory in many respects, this method, according to Mr. Murphy, lacks the simplicity which marks the cartridge method, and is less economical. The briquetting of borings by means of great pressure gives satisfactory results but the cost of preparing the briquettes is high, according to Mr. Murphy. Briquettes in which binders are used, the author states, produce castings containing pin holes and blow holes and the melting loss in the cupola amounts sometimes to 60 per cent. Castings made from similar metal, which had been charged with borings in cartridges, are sound in every respect.

Dr. Richard Moldenke, Watchung, N. J., presented a written discussion of Mr. Murphy's paper in which exceptions were taken to some of the conclusions. This discussion is as follows:

"I regret very much to differ with Mr. Murphy on some of his facts and conclusions derived in connection with the use of cast borings in foundry practice. Unquestionably all the methods he enumerates will give good results if operated under correct melting methods, and all of them will give bad results if the charging method is bad, or if the cans, briquettes or stove pipes become damaged and allow loose borings to drop into the bed and before the tuyeres.

"Mr. Murphy's estimate of the cost of the several processes is not altogether correct, as while he may be right about wooden boxes and his cartridges at $2.50 a ton ready for charging into the cupola, the method of Mr. Prince costs no more than about $1.50 a ton (exclusive of royalty) and that of briquetting under high pressures about the same. The two last methods mentioned give good results, as does Mr. Murphy's can method, where medium and heavy castings are the rule, and these will machine nicely and without blow holes if the charging and melting has been done right. For very light castings, however, particularly where high speed machining is essential, no process of using cast borings will fill the bill, as the melting of material so prone to oxidation as this is bound to harden the metal. The mistake made in introducing both the tube and the briquetting methods into foundries has been in going to specialty shops machining enormous numbers of very light castings. Here the saving in the mixture is more than offset by the extra cost of machining, and it does not pay.

"For general work, as stated, the three methods work out all right if carried out right. Mr. Murphy's can method costs most. Mr. Prince's is cheaper, but has the disadvantage of the tubes opening up and spilling the borings, if in careless hands. Briquettes made under high pressure work all right if not too large in cross section and if the pressure is sufficiently high. That Mr. Murphy's conclusion in regard to briquettes that the method is so unreliable that it is not worth pursuing, is entirely incorrect is shown by the fact that today there are 25 high pressure briquetting plants in Europe in full operation, supplying hundreds of foundries with their borings in briquette form. In this country the cost, including royalty, will run between $1.25 and $2 a ton, depending upon the weight of borings compressed at each impulse.

Melting Loss

"A further criticism I must make is in regard to Mr. Murphy's remarkable tests in melting canned borings, his loss being less than 2 per cent. I cannot accept this as possible, and rather judge that some error in manipulation has escaped Mr. Murphy's attention. I have had many samples of cast borings analyzed for their iron content. The very best of them—sold at a premium for their comparative freedom from extraneous matter—gave less than 90 per cent actual iron. Ordinarily cast borings run nearer 85 per cent iron than 90 per cent. This accounts for the comparatively poor reports gotten when any process of melting borings, whether in cans, tubes or as briquettes, is carried out, using borings only. These results show from 12 to 20 per cent loss in melting but it is forgotten that from 10 to 15 per cent of the borings was not iron in the first place.

When to Use Borings

"Again, any rusting from exposure of the borings before canning or briquetting means just so much iron removed from the possibility of melting, as iron oxide (rust) goes into the slag.

"In view, therefore, of the importance of making savings, the use of borings should be encouraged, but in their proper place. It will pay foundrymen making medium and large castings, and small castings not requiring machining, to look into the matter carefully, as economy will soon be the order of the day. The European foundrymen have done so, and the briquetting process, under very high pressure, seems to have filled the requirements best, as the tube, can and other methods of introducing borings in their loose form have not remained live issues."

In the general discussion, one speaker brought out that he had consistently encountered trouble with shrinkage holes when using borings. In another case, however, a foundry was using 200 pounds of borings to 1,700 pounds of iron, with satisfactory results and no increase in melting loss. The borings are rammed into an 8-inch diameter sheet-iron box.

C. C. Kawin, Charles C. Kawin Co., Chicago, discussed "The Use of Cheaper Materials." This paper points out particularly the economies that may be realized from the use of liberal proportions of stove plate and other scrap in gray iron foundry mixtures. Silicon, Mr. Kawin states, is one the principal elements in a cupola mixture, and he demonstrates that the proper proportions of silicon for various classes of castings can be secured when using large amounts of scrap, provided the output is watched carefully and analyses are made regularly. A number of tables are presented giving details of three all-scrap mixtures and one 75 per cent scrap mixture that are said to have been used successfully.

Alfred E. Howell, Phillips & Buttorff Mfg. Co., Nashville, Tenn., a past president of the A. F. A., gave an interesting account of his experiences during "One-Third of a Century in a Gray Iron Foundry." Mr. Howell discusses the great changes in foundry practice since 1881. At that time there was little

foundry literature. "The first writer," says Mr. Howell, "who impressed me with his clear and definite statement and logical reasoning was W. J. Keep, of Detroit. The publication of *The Foundry* was begun about 1892 and therein began to appear articles by the ablest and the best." Mr. Howell directs particular attention to notable advances in foundry practice, such as the Keep shrinkage test and the development of the aluminum match plate.

"Thermal Reactions of Cast Iron" are discussed in a paper by Thomas Turner, of the University of Birmingham, Birmingham, England. At the suggestion of the chairman, a vote of thanks was extended to Prof. Turner for his contribution. "The Application of the Match Plate to Foundry Work" was read by title only as the paper had not been printed. The author of this paper is J. K. Grill, of the International Harvester Co., Chicago.

Modern Cleaning Room Practice

H. Cole Estep, associate editor of *The Foundry*, Cleveland, interestingly explained "How Some Cleaning Room Problems Have Been Solved." The tremendous advance in cleaning room practice in recent years, according to the author, has brought this department of the foundry fully abreast of other branches. The full significance of this advance is not clearly grasped, however, and many foundrymen have failed to avail themselves of the methods and apparatus now available. Mr. Estep presented an interesting series of stereopticon views showing methods and equipment employed for cleaning castings at a number of thoroughly modern foundries.

A report was received from the A. F. A. committee on general specifications for gray iron castings, of which W. P. Putnam, Detroit Testing Laboratory, Detroit, is chairman. It was decided to continue the work of the committee during the forthcoming year. This committee will work in conjunction with a committee of the American Society for Testing Materials. The board of directors of the A. F. A. has decided to maintain the work of the various committees on specifications in conjunction where possible, with similar committees of the American Society for Testing Materials. An effort will be made to have chairmen of the A. F. A. committees serve on similar committees of the Testing Materials society.

A report was also received from the subcommittee on specifications for cast iron pipe, Alexander T. Drysdale, United States Cast Iron Pipe & Foundry Co., Burlington, N. J., chairman. This report suggested that specifications on cast iron pipe now in general use should be officially approved. The report was accepted.

The convention concluded its formal sessions Friday noon when the newly elected officers were inducted into office. J. P. Pero, the new president, in a short address, requested the active cooperation of all the members in carrying forward the work which the association has been doing in recent years. Benjamin D. Fuller, the new vice president, also spoke briefly. A resolution was adopted approving the action of the officers and directors in bringing the convention and exhibition features under one control. The secretary was directed to communicate with Chairman Fitzgerald, of the committee on appropriations of the house of representatives, calling attention to the work of the bureau of standards and urging a larger appropriation for the bureau's work.

The one-meeting-per-day plan inaugurated this year allowed the visiting foundrymen greater freedom to enjoy the various entertainment features arranged by the local committee. A ball game between Cleveland and Detroit attracted several hundred fans. Tuesday evening the foundrymen and their friends attended B. F. Keith's Hippodrome, where a vaudeville program was presented.

Wednesday at noon a luncheon was served at the Hotel Statler for the visiting ladies and at 2 o'clock they were given a sight-seeing trip through Cleveland's parks and boulevards. At the same time the men were visiting the Cleveland Furnace Co.'s plant. In the evening many of the foundrymen and their friends boarded cars for Euclid Beach where they danced and participated in the other forms of amusement provided. Many devotees of golf made use of the five links placed at their disposal during the convention by the entertainment committee.

The annual banquet, which was held promptly at 7 o'clock Thursday evening was a fitting climax to the events which had preceded it in the week's schedule of entertainment. Henry A. Carpenter, General Fire Extinguisher Co., Providence, R. I., violated all precedents by tearing up a carefully prepared speech, and entered upon the uncharted seas of toastmastership in a delightful manner. May Rosalind Pero entertained with a number of vocal selections, after which the toastmaster introduced J. P. Pero, the president-elect of the American Foundrymen's Association. On behalf of the directors of the association, Mr. Pero presented R. A. Bull, the retiring president, with a beautiful chest of silver, a token of their regard for his untiring efforts in the interests of the association.

The principal address of the evening was delivered by Hon. Newton D. Baker, secretary of war, who in a masterful way emphasized the importance of the iron industry in the affairs of the nation. Irving Bacheller gave a humorous talk. At the conclusion of the program, moving pictures of scenes taken during the convention were shown. The pictures were furnished by the Private Feature & Film Mfg. Co., Cleveland, and were taken under the direction of J. S. Smith, J. D. Smith Facing & Supply Co., Cleveland.

Casting Sheaves With Steel Arms

By Joseph L. Hollar

I have recently read some of the articles published in *The Foundry* on casting arms and hubs on sheaves. I have cast sheaves of the same type with solid hubs. Our sheaves are 8 feet in diameter and we use cores instead of a flask. We level a bed in the floor, setting the rim cores first, followed by the spokes and lower the top half of the rim with the core. We fill up the space between the spokes with sand and weight down the rim when the latter is cast. Then all the weights are removed and the core irons are dug out from the top and bottom halves of the core on four sides opposite each other. The hubs are cast the next day and these should be so rammed that the spokes can be kept covered. The spokes we use are from 1 to 1¼ inches in diameter and we experience no trouble in casting them. Our mixture consists of 30 per cent of steel scrap and 70 per cent of pig iron of the following analysis: Silicon, 2.50 per cent; sulphur, 0.06 per cent; phosphorus, 0.50 per cent, and manganese, 0.90 per cent.

The Carroll Foundry & Machine Co., Bucyrus, O., will rebuild its plant recently damaged by fire.

A foundry and machine shop will be established by Henry Schaake, Schaake Machine Works, New Westminster, B. C., Can.

The Kalamazoo Malleable Iron Co., Kalamazoo, Mich., recently incorporated with $125,000 capital stock, will build a plant which will give employment to 150 men.

The W. T. Rawleigh Co., Freeport, Ill., will erect a $400,000 steel and brick plant, including a one-story foundry, 120 x 274 feet; a craneway, 50 x 274 feet; an assembly building, 60 x 260 feet; a testing and painting shop, 60 x 300 feet, and an office and clubhouse, two stories, 40 x 230 feet.

Institute of Metals Holds Lively Meetings

Important Problems Discussed at Cleveland Convention—Foundry Session a Decided Success—Merger Plans Discussed at Length and Tabled

A SPECIAL session reserved entirely for discussions on foundry practice featured the annual convention of the American Institute of Metals, held Sept. 11 to 15, inclusive, at the Hotel Statler, Cleveland. This portion of the program, which was an innovation resulting from the renewed interest in foundry matters that has characterized the Institute's recent conventions, brought out a greater attendance than any other session. The first two days of the convention were spent in joint meetings with the American Foundrymen's Association, while separate sessions were held on the succeeding days. New and valuable information was submitted with regard to strengthening and improving aluminum alloys by the addition of manganese, and aluminum-copper alloys by the addition of iron. Among other subjects which received thorough attention were: The reclamation of brass ashes; eliminating the strains which are set up by "burning-in" brass castings; season cracking of brass; annealing properties of copper; high pressure castings; thin walled castings; metal coatings for patterns and the pressed metal process. The attendance was record breaking, the registration totaling 148, or 33 1/3 per cent of the membership of the Institute.

A proposal that the Institute be merged with the American Foundrymen's Association was unanimously disapproved. The executive committee reported that after thorough consideration, it had been deemed wise to continue the Institute as at present since a large portion of its membership is not interested in foundry practice and hence, it was feared an amalgamation with the American Foundrymen's Association would result in the elimination of matters which have no connection with foundry practice. Furthermore, it was claimed that where only one metal and a few mixtures are used in iron and steel foundries, numerous metals, in a huge variety of mixtures, are used in non-ferrous metal foundries, with the result that non-ferrous melters are apt to be more thorough metallurgists than iron and steel foundrymen. The committee furthermore decided that the identity of the Institute's work and the scope of its activities might be obscured by merging with the sister organization.

The report of Secretary W. M. Corse, Titanium Alloy Mfg. Co., Niagara Falls, N. Y., showed a decrease in membership from 314 to 300 in the year ending July 1, 1916. Since July 1, however, approximately 40 new applications have been received, with the result that the membership now is about 340. Mr. Corse also reported the association to be in splendid condition financially. He recounted the activities of the Institute during the year; among these were meetings by a committee representing the Institute, with representatives of the United States bureau of standards, designed to promote co-operation on questions of common interest. Such meetings are being held twice a year.

JESSE L. JONES, AT THE RIGHT, RE-ELECTED PRESIDENT A. I. M., ENJOYED THE CONVENTION

An interesting communication from Dr. George K. Burgess, of the bureau, was read. This directed the attention of the Institute to the handicaps under which the bureau is working. Dr. Burgess pointed out the need for additional support in order that its staff and facilities may be enlarged sufficiently to enable it to pursue research work in connection with important subjects which for some time past have been awaiting attention. An appropriation of $50,000 by congress would go far toward enlarging the bureau's scope, said Dr. Burgess, and he suggested that the Institute follow the example of other leading engineering and technical organizations in endeavoring to enlist the interest of congress in this matter.

In order to co-operate more effectively with the bureau, members of the Institute were requested to consider the bureau as a clearing house for information on various metal alloys. The bureau is desirous of securing all possible information with respect to all alloys now in use. It was suggested at the meeting that companies manufacturing alloys of any kind forward to the bureau such facts with reference to these alloys as they have ascertained. The bureau, it is understood, will be glad to furnish other data on these alloys, including, for instance, the physical characteristics which can be obtained only with the aid of delicate machines or instruments.

W. H. Bassett, American Brass Co., chairman of the committee on the standardization of crucible sizes, submitted a report containing a list of proposed standard sizes for crucibles. This report, which was compiled after extended conferences with leading brass foundrymen and manufacturers of crucibles, was accepted but not acted upon by the Institute.

The foundry session brought out a number of notable papers among which was a contribution by Charles Pack, Doehler Die-Casting Co., Brooklyn, on "The Evolution of the Die-Casting Process". This paper embraced a study of the metal casting processes of all ages and was illustrated by lantern slides showing casting practice as depicted upon Egyptian tombs built as early as 1500 B. C. The illustrations included views which portrayed the gradual advance in casting methods up to the present time.

Mr. Pack concluded his paper with a general discussion of the die-casting industry as it now exists. After finding tin and lead alloys to be too soft for most purposes, said Mr. Pack, a series of zinc base alloys was adopted by his company. Such alloys are used for making a large variety of castings, including magneto housings, talking machine castings, a great many automobile castings, automatic vending machine

castings, castings for electrical devices, and a great many others in which low tensile strength and facility toward corrosion are not objectionable. Of late, said Mr. Pack, there has been an enormous demand for aluminum and brass die-castings which has been met with castings made from No. 12 aluminum-copper alloys. Castings of this alloy, he said, now are used on possibly 75 per cent of the high grade motor cars produced in this country. Aluminum castings, he said, now are being produced in larger volume than zinc alloy castings.

In a paper entitled "The Brass Foundry", E. A. Barnes, Fort Wayne Electric Co., Fort Wayne, Ind., compared conditions in the brass foundry today with those that prevailed 30 years ago. At that time brass foundries could select only between coke and hard coal as a fuel, whereas today gas, coke, coal, oil fuel and electricity are available, each having its own particular sphere of usefulness. Mr. Barnes also mentioned the use of compressed air on molding machines and other factors which have enlarged and improved the output of brass foundries. He described the successful attempt which his company recently made to discover a duplex thermostatic metal which would withstand both rolling and annealing. The author described his experience in lengthening the life of wood patterns. Wood patterns which soon wear and warp when unprotected, have been found to be much more durable when coated with metal by the Shoop process. With the Shoop pistol, Mr. Barnes said, copper or lead coatings may be applied to fragile and even complicated wood patterns, and the patterns coated by this process have given surprisingly satisfactory results. He also described efforts to make aluminum castings which would take a high polish; these were successful when 8 to 10 per cent tin was added to an aluminum-copper mixture.

The Compressed Metal Process

Mr. Barnes also described the manufacture of brass and aluminum parts by the compressed metal process. Castings which are required to be more homogeneous, tough, and perfect than could be made by ordinary casting methods, are produced at the Fort Wayne plant by pressing metal blanks or bars into steel molds. Portable hydraulic presses are employed and exceedingly intricate work reproduces perfectly by this method. The author expressed his belief that the greatest advances in foundry practice in the near future may be expected to develop in the melting department.

In discussing Mr. Barnes' paper, Charles Pack described tests which he made on lead and tin coatings which were applied by the Shoop method. The coatings of these metals in addition to being unhomogeneous, were deposited in such a manner that sharp corners were rounded out. P. E. McKinney, in concluding the discussion, said that treatment with the sand blast, using fine sand, finishing the work on a buffing wheel, smoothes the coating sufficiently to close up porous portions, thus rendering the coating impervious to corrosive agents.

Copper-Aluminum-Iron Alloys

That the physical properties of binary alloys of copper and aluminum may be improved by adding a small iron content was brought out in a paper by W. M. Corse and G. F. Comstock, entitled "Some Copper-Aluminum-Iron Alloys".

AN ARGUMENT OVER BINARY ALLOYS

The use of iron increases the tensile strength and the hardness, and particularly the yield point. Experiments were made in the use of iron in connection with the standard aluminum bronze produced extensively by the Titanium Alloy Mfg. Co., which contains 10 per cent aluminum and 1 per cent iron; these experiments were made with varying amounts of iron in bronzes containing 7 to 10 per cent aluminum, inclusive. The changes in characteristics resulting from the use of iron were found decidedly advantageous in adapting the alloy to special uses; in some cases it was found desirable to have only a little aluminum and in others to have considerable aluminum content. One marked feature is that the addition of iron serves to break up the large crystalline growths which always are present in binary alloys. The paper contained the results secured from alloys containing varying percentages of iron in connection with varying percentages of aluminum.

An interesting addition to the Institute's literature on the subject of seasoning cracks and self-annealing of brass was presented by W. Arthur, Frankford arsenal, Philadelphia. Since it requires several years for self-annealing or season cracking to manifest itself to any marked degree, Mr. Arthur said, it is to be expected that any extended study on this subject would be much delayed. The author mentioned numerous instances of season cracking, especially in cartridge cases, artillery cases, etc., and he described changes in the manufacturing processes which have resulted in decreasing the liability of deterioration of this material. Mr. Arthur was inclined to believe that there is no evidence at present which shows that impurities such as lead and cadmium are responsible for season cracking and self-annealing.

In discussing this paper, George C. Stone, New Jersey Zinc Co., agreed with Mr. Arthur that the causes of season cracking have not yet been definitely determined, but he contended that the presence of cadmium at least is a contributing cause. The strains developed in the cold working of brass, Mr. Stone believed, are the most important cause. Mr. Arthur was of the opinion that unless some way of eliminating season cracking is discovered, new alloys which would not be subject to failures of this kind, will be developed for the manufacture of cartridge and artillery cases.

Manganese is Desirable

P. E. McKinney, Washington navy yard, presented a paper entitled "Aluminum Castings and Forgings". The use of manganese, with or without copper, when employed in relatively small quantities, hardens and strengthens aluminum without destroying its ductility. The machining properties are excellent and the comparatively small amount of hardener used makes possible a specific gravity in the finished alloy from 0.35 to 0.40 less than that of the ordinary No. 8 alloy. When properly made, Mr. McKinney said, these alloys are practically free from hot shortness and the most intricate castings can be produced with comparative ease. Despite the contention that the use of special melting furnaces and equipment is necessary to produce good aluminum alloys, the author found that alloys of aluminum containing manganese can be melted in natural-draft pit furnaces provided ordinary precautions are preserved in melting and fluxing the metal. The most satisfactory method of introducing the hardening elements is by alloying them with a small amount of aluminum, making a rich hardener of definite proportions and comparatively low melting point.

The most dangerous impurities encountered in aluminum alloys are carbon, silicon and iron; hence the greatest care must be taken to prevent the introduction of these ingredients either in the metal used or through the medium of crucibles and tools. The paper included some valuable information on the manufacture of aluminum forgings.

The discussion which followed this paper concerned itself chiefly with crucibles employed in the melting of aluminum and aluminum alloys. In reply to questions, Mr. McKinney said it is questionable practice to use crucibles from which harmful elements might be absorbed by the metal. Cast-iron crucibles, despite the fact that they are used on a large scale for melting aluminum, he was inclined to regard as undesirable and he recommended that wrought-iron crucibles would prove less harmful than cast iron. In the Washington navy yard, he said, the care which is exercised to prevent exposure of the metal to undesirable elements extends so far that the crucible skimmers are covered with clay. Graphite crucibles, Mr. McKinney said, may be used for making aluminum alloys, although he recommended that they be provided with a lining low in silicon.

Tests of Zinc-Bronze Bars

C. P. Karr, United States bureau of standards, submitted a report on a series of comparative tests of zinc-bronze test bars. These bars, which were composed of an alloy containing 88 per cent copper, 10 per cent tin and 2 per cent zinc, were cast from the same mixtures in five foundries. Some of them were cast in sand and others in chill molds; one set was cast from virgin metal, another from remelted metal and the third from a remelt of the first two melts. The bars made from virgin material showed a greater tensile strength, elongation and reduction of area, than the bars made from the first and second remelts. In the case of both the virgin and the first remelted material, the chill cast bars ,showed markedly better results than the sand cast bars. The bars made from the second remelt showed a marked deterioration in all their physical properties. The tests showed that for sand cast specimens a tensile strength of 33,000 pounds per square inch can be specified fairly, with an elongation of 10 per cent and reduction of area of 9 per cent, while for chill cast specimens requirements of 40,000 pounds tensile strength, 22 per cent elongation and 18 per cent reduction of area easily can be met.

Dr. Paul D. Merica and C. P. Karr, bureau of standards, presented the results of an investigation of the initial stress produced by "burning-in" manganese bronze castings. This investigation was made in order to determine the reason for the cracking of castings which had been burned-in. The paper is presented in full elsewhere in this issue.

E. Jonson, New York board of water supply, submitted an interesting paper on defects to which brass and bronze castings are subject, and which cannot be located by ordinary surface examination or by hydrostatic testing. A large percentage of these defects arise from the presence of oxide in the casting, Mr. Jonson said. The only way to prevent the defects due to oxide is to design and gate the mold in such a manner that the oxide will not flow in with the metal. The only way to determine whether or not a metal is sound, he said, is to test it for tensile strength. No brass or bronze mixture should

W. M. CORSE,
Secretary, A. I. M.

show leakage at 1,000 pounds pressure. If it does, he said, such failure is due to the fact that the metal is not clean. Trouble frequently is encountered, Mr. Jonson said, by not designing the mold properly. Heavy sections of castings, for instance, should not be fed from a riser through thin sections since by such an arrangement the metal in the riser would be available to the heavier sections only up to the point where the thinner sections solidify. In order to produce sound castings, Mr. Jonson said, the mold should have sufficient risers and the use of extensive flat surfaces at the top of the mold should be avoided.

Russell R. Clarke followed Mr. Jonson's paper with a discussion in support of the use of bottom gates. It had been his experience, said Mr. Clarke, that all castings, whether light, medium or heavy, can be gated from the bottom, and the percentage of discount is very much smaller when this system is adopted than when the mold is gated from the top. Among the many advantages of the bottom-pour method is the fact that pin holes never are found at the junction of the gate and the casting.

S. W. Miller, Rochester Welding Works, Rochester, N. Y., submitted an exceedingly interesting paper on the use of the oxy-acetylene flame in burning-in brass and manganese bronze castings. After extensive experiments, Mr. Miller said, he had discovered a material which would weld with all kinds of brass and bronze, with the exception of admiralty or gun metal; it was found impossible to weld the latter due to the development of a porous structure immediately surrounding the weld. In the experiments conducted by Mr. Miller, it was found that material containing tin was entirely unsatisfactory for welding tin-containing castings, since the presence of this metal increased the amount of the eutectoid present. The presence of zinc also was found to be undesirable, since it rendered the weld porous. The metal which he finally found satisfactory for welding brass and manganese bronze castings consisted of copper, iron and aluminum in the proper percentages. With reference to making welds in manganese bronze castings, Mr. Miller said the essential element in the welding mixture was aluminum, although only a very small content of this metal is necessary. In fact less than 0.05 per cent is desirable. Mr. Miller exhibited a number of photographs showing the results obtained in making typical welds in manganese bronze castings. He also exhibited a number of specimens of the metal which he has developed for use in making welds.

Tinned Sheet Copper Corrosion

Dr. Paul D. Merica submitted a report of an investigation of the corrosion of tinned sheet copper. It was found that tinned sheet copper corrodes only where the surfaces of tin have been penetrated by scratches, etc. Covering the copper, where the outside coating of tin has been removed by scratches, is an alloy layer which is electro-negative, and which is less readily corrodible than copper; at these points the copper and alloy layer form a galvanic couple, the copper being attacked more readily than if the alloy were not present. All tinned sheet copper is subject to such corrosion since the present process of tinning always produces the intermediate layer of alloy, which acts as an accelerator of corrosion once the underlying copper has been exposed. In discussing Dr. Merica's paper, several speakers agreed that such corrosion will not take place

unless the surface of the tinned copper has been scratched or abraded so as to penetrate the coating of tin.

J. M. Bateman submitted a paper describing the methods pursued by the Hawthorne Works of the Western Electric Co. in disposing of its old metal. The monthly raw material input in this plant approximates $1,500,000 in value, and the waste material which collects during a similar period is about as follows: Brass, 100 tons; copper, 180 tons; German silver, 17½ tons; iron and steel, 89 tons; solder skimmings, 4 tons; lead, 833 tons. The author described the bundling and baling presses which are employed for pressing a large portion of this material into forms in which it can be handled conveniently. Chips, turnings and sweepings are separated from dust and dirt in a mechanical separator, and then are put through a magnetic separator which separates the iron and steel from the brass. The company has improved its method of reclaiming junked cable. Such cable first is placed in ovens where it is held until the lead sheet has been melted and the paper insulation burned from the wire. The molten lead is run directly into a refining furnace, where it automatically is separated from the paper ash and other impurities. The metal is turned from the refinery furnace into molds. Some of the resulting lead can be used in the press room, but much of it is sold, due to the fact that its percentage of impurities is too great to permit it to meet the requirements demanded in the manufacture of cable. The copper wire remaining in the furnace is compressed into briquette form before being sold.

Reclamation of Brass Ashes

Arthur F. Taggart, assistant professor of mining engineering, Sheffield scientific school, Yale university, submitted a paper on "The Reclamation of Brass Ashes", which was read by title. A great deal of metal is wasted each year, said the author, due to the unsatisfactory methods which are pursued by brass foundries generally in reclaiming the metal and unburned fuel in brass ashes. He gave analyses of typical ashes which showed the copper content to range all the way between 2.9 and 23.2 per cent, thus proving it absolutely essential in the interest of economy to devise a method by which most of this metal will be saved. Professor Taggart commented on the crude reclaiming plants which are used in many brass shops. These usually consist of a picking table from which coarse metal and lump coal are removed; a grinder with restricted discharge, and a screen, which is employed to hold the reclaimed metal. Such a method, he said, is uneconomical. The author then described a desirable method of reclaiming ashes, which must be varied according to the character and quantity of the ashes, etc. The method suggested, he said, has worked satisfactorily.

In discussing this paper, W. M. Corse described the experience of the Titanium Alloy Mfg. Co., Niagara Falls, N. Y., in reclaiming metal from ashes. Originally the company treated the ashes in a Hill crusher, reclaiming the metal with a hydraulic classifier. This method resulted in saving all but 8 to 10 per cent of the copper. The present method comprises the use of a concentrating table in conjunction with the crusher, and the company now reclaims all but about 0.125 per cent of the copper in the ashes. The company has improved its reclamation process considerably by operating its crusher constantly instead of intermittently. Instead of stopping the machine when it fills up with ashes or screenings in order to dump them out, the concentrated material is removed by means of a long-handled ladle as fast as it accumulates. As a result, 95 per cent of the metallic residue is reclaimed.

Thin-Walled Castings

R. S. B. Wallace, of the National Cash Register Co., Dayton, O., presented a paper on "The Manufacture of Thin Walled Ornamental Castings of Large Area, in Brass and Bronze". He discussed fully all the factors which enter into the problem, including the sand and its preparation, the equipment, the methods of molding the composition and melting of the metal and the cleaning of the castings.

S. D. Sleeth, Westinghouse Air Brake Co., Wilmerding, Pa., generally recognized as one of the foremost authorities on the manufacture of castings to withstand pressures, submitted an interesting paper on this subject. Mr. Sleeth dealt particularly with brass and bronze, and his paper included the compositions of three alloys which he has employed.

Dr. Henry S. Rawdon, bureau of standards, presented a paper on "The Occurrence and Significance of Twinned Crystals in Electrolytic Copper". Dr. Rawdon also was scheduled to submit a paper entitled "Deterioration of Muntz Metal". The presentation of this paper, however, was postponed, due to the desire of the author to make further research work on this subject. A paper on "German Silver as Applied to the Optical Trade", which was scheduled to be presented by G. C. Holder, was withdrawn. G. V. Caesar and G. C. Gerner jointly submitted a paper entitled "The Annealing Properties of Copper at Temperatures Below 500 Degrees Cent., With Particular Reference to the Effect of Oxygen and of Silver." F. L. Antisell, Raritan Copper Works, Perth Amboy, N. J., presented a paper on "The Manufacture of Electrolytic Copper". C. H. Mathewson, director of Hammond laboratory, Yale university, presented a paper entitled "Co-operation With the Metal Industries in Metallographic Work", which was read by title. William B. Price and Philip Davidson, Scovill Mfg. Co., Waterbury, Conn., presented a paper entitled "Physical Tests on Common High Brass Taken Parallel and at Right Angles to the Direction of Rolling."

Election of Officers

Jesse L. Jones, Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., was reelected to the office of president. W. M. Corse, Titanium Alloy Mfg. Co., Niagara Falls, N. Y., was reelected secretary; George C. Stone, New Jersey Zinc Co., Palmerton, Pa., was elected senior vice president, and other vice presidents were elected as follows: R. S. B. Wallace, National Cash Register Co., Dayton, O.; W. B. Price, Scovill Mfg. Co., Waterbury, Conn.; George K. Burgess, United States bureau of standards, Washington; DeCourcy Browne, Goldschmidt Thermit Co., New York; Harold J. Roast, James Robertson Co., Ltd., Montreal; J. P. Salter, Ohio Brass Co., Mansfield, O.; F. H. Schutz, H. B. Mueller Mfg. Co., Decatur, Ill.; W. A. Cowan, National Lead Co., New York, and H. S. Gulick, Moore-Jones Brass & Metal Co., St. Louis. The nominating committee was as follows: Chairman, G. H. Clamer, Ajax Metal Co., Philadelphia; L. W. Olson, Ohio Brass Co., Mansfield, O., and N. K. B. Patch, Lumen Bearing Co., Buffalo.

The need for the distribution of information as to methods of making hydrostatic tests of different alloys was brought to the attention of the convention by C. P. Karr and P. E. McKinney. A discussion on this subject resulted in the adoption of a motion referring the need for a standard testing method to the American Society for Testing Materials.

As a result of a resolution adopted at one of the joint sessions, President Jones appointed a committee whose duty it will be to formulate a code on fire prevention. This committee is comprised of C. E. Skinner, Westinghouse Electric & Mfg. Co.; F. C. Clements, National Cash Register Co., Dayton, O.; F. P. Sinn, New Jersey Zinc Co., Palmerton, Pa.

Foundry Exhibition a Big Business Success

Displays in Cleveland Coliseum Reflected the Spirit of the Times—Progress Seen in Design and Construction of Equipment—Attendance Phenomenal

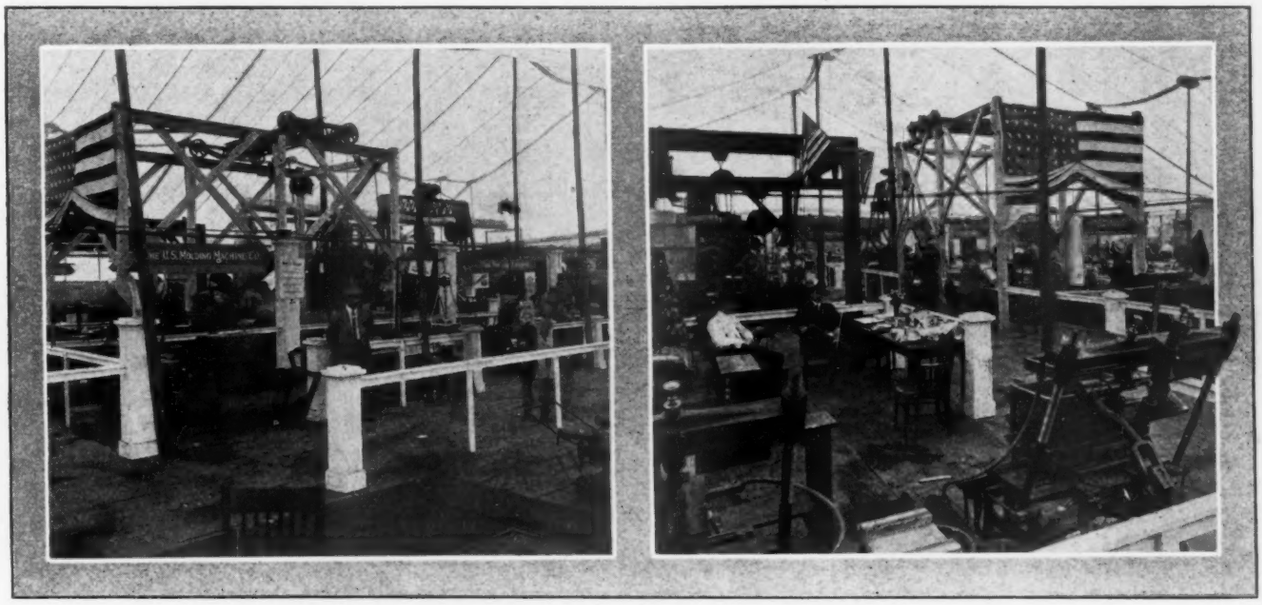
THE eleventh annual exhibition of foundry and shop equipment, held in Cleveland simultaneously with the joint conventions of the American Foundrymen's Association and the American Institute of Metals, was notable for the completeness with which the entire range of foundry operations was covered. The displays shown by the 145 exhibitors covered every phase of a modern foundry's activities from the time the raw materials are purchased until the final book entry is made covering the sale of the finished castings. The raw materials, that is the pig iron, coke and sand, were on exhibition. Complete equipment for the molding room, pattern shop and cleaning room also were on display, and in addition improved devices and methods of handling the work in the auditing, sales and advertising departments were presented. No foundry in the country is as completely equipped with modern labor-saving and cost-reducing equipment as the Cleveland coliseum and annex was during convention week. The well rounded character of the exhibition proved its greatest attraction.

It was peculiarly appropriate, for two reasons, that the largest, most complete and best attended exhibition ever given concurrently with the annual conventions of the two great allied foundrymen's associations should take place in Cleveland. The first exhibition of foundry and shop equipment ever held was given in Cleveland 10 years ago, the last time these two great organizations met in that city. The exhibition was inaugurated by enterprising foundrymen of what is now the Sixth city and was an immediate success. The second reason, which gave this year's exhibition added interest, was that in the place where the idea of a simultaneous exhibition first originated, the complete amalgamation of the exhibition and convention features under one management was finally concluded. This year the two foundry organizations took over the work of conducting the exhibition, through the appointment of a special exhibition committee. The success which met their efforts was amply testified to by the unusual interest taken in the exhibition and by the fact that the show was the largest of its kind ever held.

A comparison of the two Cleveland exhibitions, one held in 1906 and one last month, affords an instructive insight into the marvelous growth of the foundry industry in the past decade. The first show attracted 42 firms, their exhibits occupying about 12,000 square feet of floor space. The exhibition which was thrown open on Sept. 12, attracted 145 firms and more than 70,000 square feet of floor space were required to display properly the immense quantity of equipment installed solely for this five-day show. A 55-horsepower gas engine furnished enough power to drive all operating equipment at the 1906 show. Specially installed power lines furnising 900 horsepower were required at the 1916 show.

Cleveland's first exhibition was held in the Central armory, a building 120 x 207 feet. The exhibition which was spoken of at the time as a "unique feature," occupied only part of this space as much more than half of the room was given over to the speaker's stand and chairs for the business sessions. This year's exhibition was held in the Coliseum, a building designed especially for this purpose, but its 60,000 square feet of floor space proved inadequate and most of the operating equipments were displayed in a specially built annex, having 10,000 square feet of floor space or almost as much as the entire exhibition required 10 years ago.

The indirect influence of the European war could be clearly traced in the many mechanical improvements exhibited this year. This influence was exerted in several ways. The generally prosperous condition of the foundry industry has enabled foundrymen and builders of foundry equipment to increase their appropriations for experimental work. At the same time, wartime prosperity has laid emphasis on repetition work, foundries frequently receiving



THE WORKING EXHIBITS IN THE ANNEX ATTRACTED UNUSUAL ATTENTION

orders for dozens and hundreds of castings, where they had previously received orders for one or two. This cry for increased production was reflected in many of the exhibits, which showed refinements in design that permit the adaptation of machines to work previously considered out of the field of those particular machines.

Numerically the 1916 exhibition was fully up to previous standards. Artistically it took high rank, the specially designed Coliseum affording an ideal setting for displaying the exhibits to their best value. Mechanically the show is believed to have surpassed all previous exhibits in its array of highly specialized equipment.

The advances made in the mere size of the exhibits have been overshadowed by the improvements in foundry equipment itself. *The Foundry* in describing the 1906 exhibition pointed out that one exhibitor was showing "the only completely automatic molding machine made." The wonderful strides in the development of labor-saving machines for the molding room alone are clearly attested by the imposing array of combination molding machines which were on display in the Cleveland coliseum. The field of the molding machine has been steadily expanded, each year's exhibition emphasizing the tendency to supplant still further the employment of hand labor. The molding machines which were displayed indicate that the energies of their designers in the past 12 months have been turned along similar lines, that is, in adapting the machines for work that previously had been considered suitable for bench molding only.

The Osborn Mfg. Co., Cleveland, displayed the complete line of molding machines that it manufactures. This included roll-over jar-ramming machines, stripping-plate jar-ramming machines, split-pattern machines, air squeezers, stripping-plate machines and plain jar-ramming machines. Three of the machines exhibited are developments of the past year. These are a portable jar-ramming stripping-plate squeezer, a portable roll-over jar-ramming machine and a jar-ramming stripping plate machine, the last two being adapted to run on a track. These machines are designed particularly for handling small, duplicate work. The jar-ramming stripping-plate squeezer is equipped with a head which runs on ball bearings on a track into position for squeezing. The jar-ramming stripping-plate machine is suitable for many classes of work now handled on the bench. The jar-ramming stripping-plate squeezer follows the design of other Osborn machines of similar type, being smaller, however, and portable.

The E. H. Mumford Co., Elizabeth, N. J., exhibited its extensive line of molding machines. Particular attention was attracted to a 14 x 16-inch split-pattern combination jar-ramming squeezer, a 12-inch combination plain squeezer and jar-rammer, a 10-inch high trunnion combination jar-rammer and squeezer and a 37-inch jar-ramming, roll-over draw machine. The 10-inch and 37-inch machines were placed on exhibition for the first time at the Cleveland show. The operation of the jolt roll-over draw machine is as follows: The pattern board is placed directly on the jolt rammer table by means of a positive spring locking device. After the flask is filled, it is rammed up by the jolt cylinder. When the ramming process is complete, the mold is clamped to the pattern board, and the rock-over valve is opened. As soon as the arms start upward in the rolling-over operation, they are automatically locked to the pattern board by means of sliding pins. This takes place as soon as the arms move upward ¼ inch, so danger of the pattern board slipping is eliminated. The rolling-over operation is achieved by means of a 16-inch air cylinder acting in either direction on a crank. When the mold is rolled over it hangs suspended by the arms over the leveling and pattern drawing device. This device consists of a fluid pressure plunger. In operation the draw plunger raises up the leveling device to a height of 16 inches, the maximum draft, when a stud opens a pop valve releasing four leveling pins which rise independently of each other until they strike the bottom board of the flask. As they are independent of each other any inequality in the surface of the board is automatically taken up, and the pins being 22 inches in length, no adjustment is necessary for shallow or deep flasks. When the pins have come to rest under the bottom board they are locked by means of an air clamp from the operating position. This clamp exerts a pressure of three tons on each separate pin, thus assuring a rigid rest for the flask. Hand levers for locking the pattern board to the arms, and also for locking the leveling device are not employed. When the flask has been leveled, the pattern is drawn by means of the fluid pressure plunger.

The extensive line of molding machines manufactured by Henry E. Pridmore, Chicago, was on display. These machines, as in the case of many of the other molding machines, were shown in operation in the Coliseum annex. The exhibit was arranged to show the development of the Pridmore machines, from the rock-over drop machine, to the power rock-over drop and the combination power rock-over drop and jar-ramming machines. The two latter are operated by compressed air and electricity. Considerable interest was aroused by the new air locking device with which the latter machines are equipped. The plates are automatically locked before rolling over, the frame as it starts upward releasing a valve which connects with a cylinder that brings the locking mechanism into play. The pattern drawing operation is performed with both air and oil, the oil entering the cylinder and acting as a cushion, thus insuring an even draw. The complete exhibition included a 16 x 14 x 5-inch rock-over drop machine, a 24-inch power rock-over drop and combination jar-ramming machine, a 30-inch combination power rock-over and jar-ramming machine, an 8-inch squeezer, a 29 x 24-inch power rock-over drop machine, a 16-inch electrically driven jar-ramming stripping plate machine and two 10 x 12-inch stripping plate machines.

The Arcade Mfg. Co., Freeport, Ill., had on display a complete line of molding machines. This company's 24-inch power roll-over jar-ramming machine, which was exhibited, is fitted with a specially designed leveling device which is self adjustable. This device is not locked but is held by the weight of the flask. A special jar-ramming stripping plate machine was also shown. With this machine, the stripping plate is raised and the flask released from the mold in one operation. Four supports

Such is Fame

"Really Old Man I must see Hoyt—it's very important you know. Can't you help me out?"

The gentleman to whom this question was addressed reflected, and then he in turn became interlocutor.

"You have never seen Mr. Hoyt?"

"Don't know him from Daddy Seaman!"

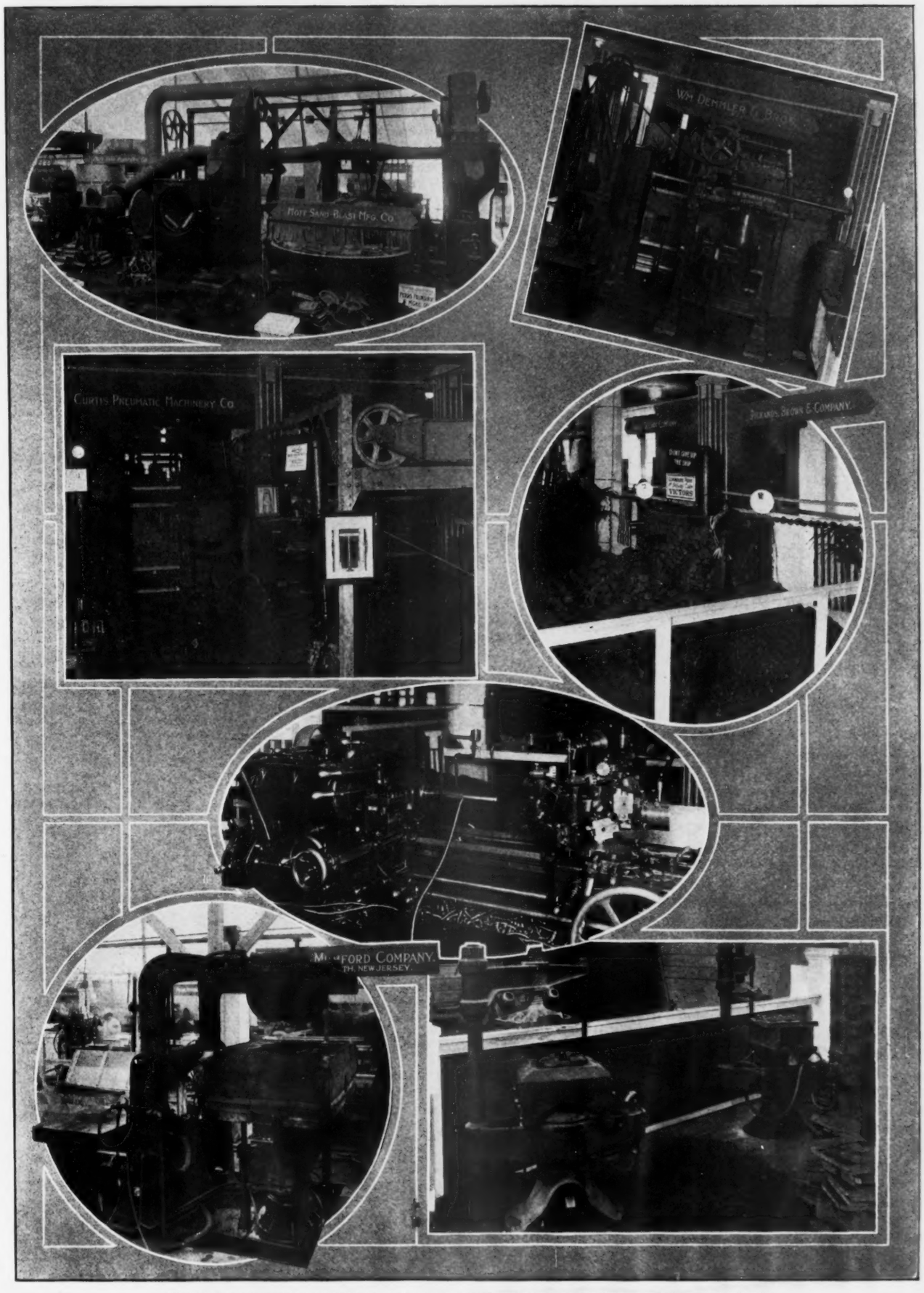
"Hm! Well, this Hoyt person is not represented in the rogue's gallery, but this", thumbing over a well known trade journal, "is the next thing to it. Here he is—perfect likeness too. You better subscribe, it's only four dollars—"

The sales talk was wasted. The inquirer's attention was riveted on the printed likeness of the manager of exhibits, which he studied carefully, even minutely.

"I guess I can recognize him now, thank you."

He strolled off searching every face for a full ten minutes, and then feeling the need for Lady Nicotine to aid him in his search, he paused, felt his pockets and accosted a stranger for a match.

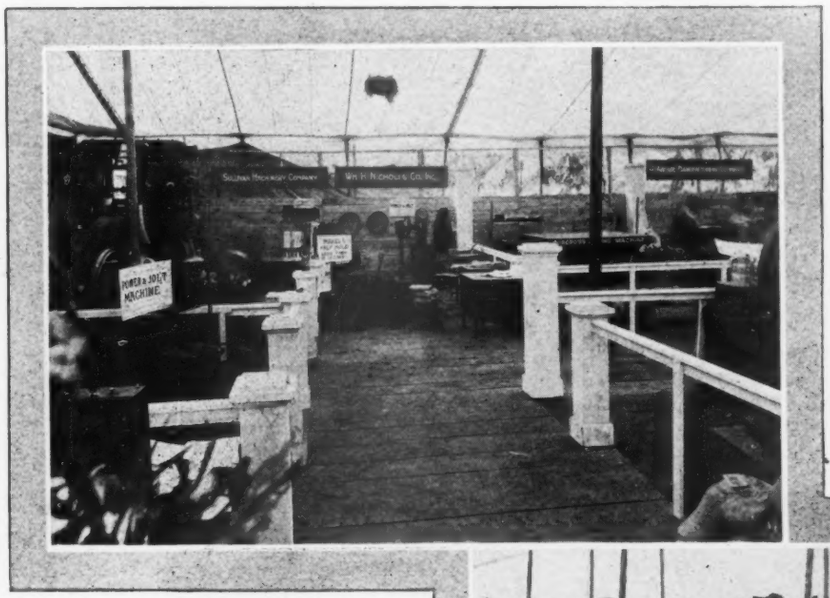
"Sure, take the box", said Hoyt, with characteristic generosity and passed on.



EVERY PHASE OF FOUNDRY ACTIVITY WAS FULLY COVERED BY THE EXHIBITS

come into play automatically and carry the flask while the pattern is lowered. The flask is then removed and a touch on a lever releases the supports, the machine then being ready to receive the next flask. The exhibit also included Modern molding machines, Norcross jolt-ramming machines, core jar-ramming machines, and air and hand squeezers.

The Berkshire Mfg. Co., Cleveland, displayed its standard automatic type of machine which not only performs



A BUSY CORNER IN THE ANNEX

molding operations but is equipped with elevators, hoppers and sifting devices for riddling and handling the sand. Particular attention was drawn to a 12-inch universal jolt-ramming machine. This machine has only two valves instead of four and is especially designed to protect all wearing parts from sand. Air and hand-operated squeezer machines as well as vibrators, knee-valves and miscellaneous foundry equipment were on display.

The Midland Machine Co., Detroit, exhibited a jolt-ramming roll-over pattern-drawing machine provided with a special car for delivering the molds to the floor, and one hand roll-over molding machine. The former machine is operated from one position. A turn of a lever starts the jolting mechanism. The lever is turned in the same direction to clamp the pattern. The flask is then rolled over, and the lever reversed thus drawing the pattern. The buggy is then run in and the mold run out on the floor. The machine has been redesigned recently, the head being doubled in length and the guides and table strengthened.

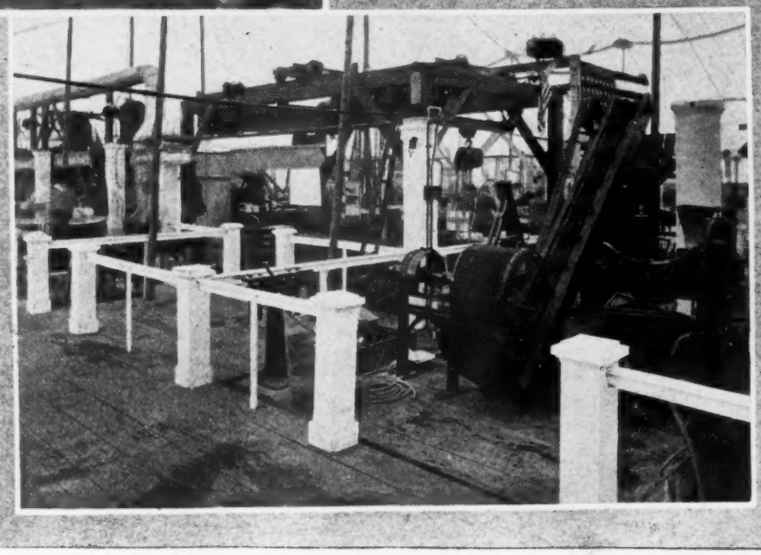
The Mumford Molding Machine Co., Chicago, exhibited a 10-inch high trunnion squeezer. The distinctive feature of this machine is that the trunnion carrying the crusher board swings up and back as opposed to the strain rod type of squeezer. Several safety devices have been installed as well as a new Hanna suction oiler.

The B. & B. Mfg. Co., Indianapolis, had on display a 30-inch hand jar-ramming and squeezer molding machine of the stationary type, a 30-inch power machine with a 12-inch power unit of the portable type, and a 24-inch stationary power machine with a 10-inch power unit. The same squeeze is obtained on all molds as after the predetermined amount of squeeze is obtained, further pressure releases the squeezer. This feature is provided to permit the employment of unskilled operators. A feature of the 30-inch power machine is the provision of two whistle valves—one intake and one exhaust—which are fitted with renewable discs, thus facilitating repairs. The machine is provided with two heavy guide posts with the sleeves babbitted to the frame. These sleeves can be rebored and new guide posts fitted.

The U. S. Molding Machine Co., Cleveland, had a complete exhibit covering its extensive line of molding machines. Interest was drawn particularly to a combination jar-ramming squeezer roll-over pattern-drawing machine. This machine makes the mold complete without any hand work and is said to do away with peening or butting off. A counterbalanced air cylinder insures steadiness in the operation of the machine.

A model of the roller-ramming molding machine built by the Moldar Co., Maspeth, N. Y., was exhibited. This machine eliminates hand ramming. The Herman Pneumatic Machine Co., Zelienople, Pa., displayed a small jar-ramming machine. The American Molding Machine Co., Terre Haute, Ind., had a 22-inch jar-ramming machine on display.

The Davenport Machine & Foundry Co., Davenport, Ia., had its booth fitted up as a rest room. Photographs of the company's line of labor-saving molding devices were shown. The International Molding Machine Co., Chicago, also showed photographs of its line of molding machines and entertained visiting foundrymen at its booth in the Coliseum.



CRANES, HOISTS AND SAND ELEVATORS WERE INCLUDED IN THE DISPLAY

The S. Obermayer Co., Chicago, exhibited a new type of portable, stripping plate molding machine especially adapted for automobile work. This machine is designed for use with unskilled labor and is heavily constructed and simply arranged.

The Federal Foundry Supply Co., Cleveland, displayed a line of molding machines, squeezers, snap flasks, pour-

ing devices and electric riddles as well as foundry facings and supplies. Of particular interest is a bench stripping-plate device which is adjustable for any size of snap flask. It has a lift of 8 inches, half for the pattern and half for the flask. It is operated by foot power. The jar-ramming core machines exhibited are provided with clamps for clamping the flask, leaving the operator free to handle the sand.

The Malleable Iron Fittings Co., Branford, Conn., had on display a complete line of vibrators, from ⅜-inch to 2 inches inclusive, and exhibited for the first time a full line of accessories such as valves, fittings and clamps suitable for the installation of vibrators on molding machines. The vibrators are steel. A vibrator attaching device was also shown which can be attached to mold boards and patterns.

The Manitowoc Electric Implement Co., Manitowoc, Wis., in addition to direct-current plate, bench and tub vibrators, exhibited a newly designed alternating-current plate vibrator. This vibrator can be attached to a lamp socket eliminating the motor generator set. It is built in four sizes.

The T. B. Wood's Sons Co., Chambersburg, Pa., showed its equipment for the system of taper flask molding introduced by this company including tapered snap flasks and automatic adjustable snap jackets. Both flasks and jackets were shown in a wide number of sizes.

The William H. Nicholls Co., Brooklyn, N. Y., displayed a plain combination power and jolt squeezer, a combination power and jolt squeezer for split pattern work which was equipped with a gravity throwing device, a plain combination power and jolt squeezer fitted for light split pattern work and a combination power and jolt squeezer fitted with a roll-over and pattern-drawing device. These machines were shown in operation, molds being made in 8 to 10 seconds on the combination power and jolt squeezer for split pattern work. With this machine, the jolting, squeezing and pattern-drawing operations are controled by one valve.

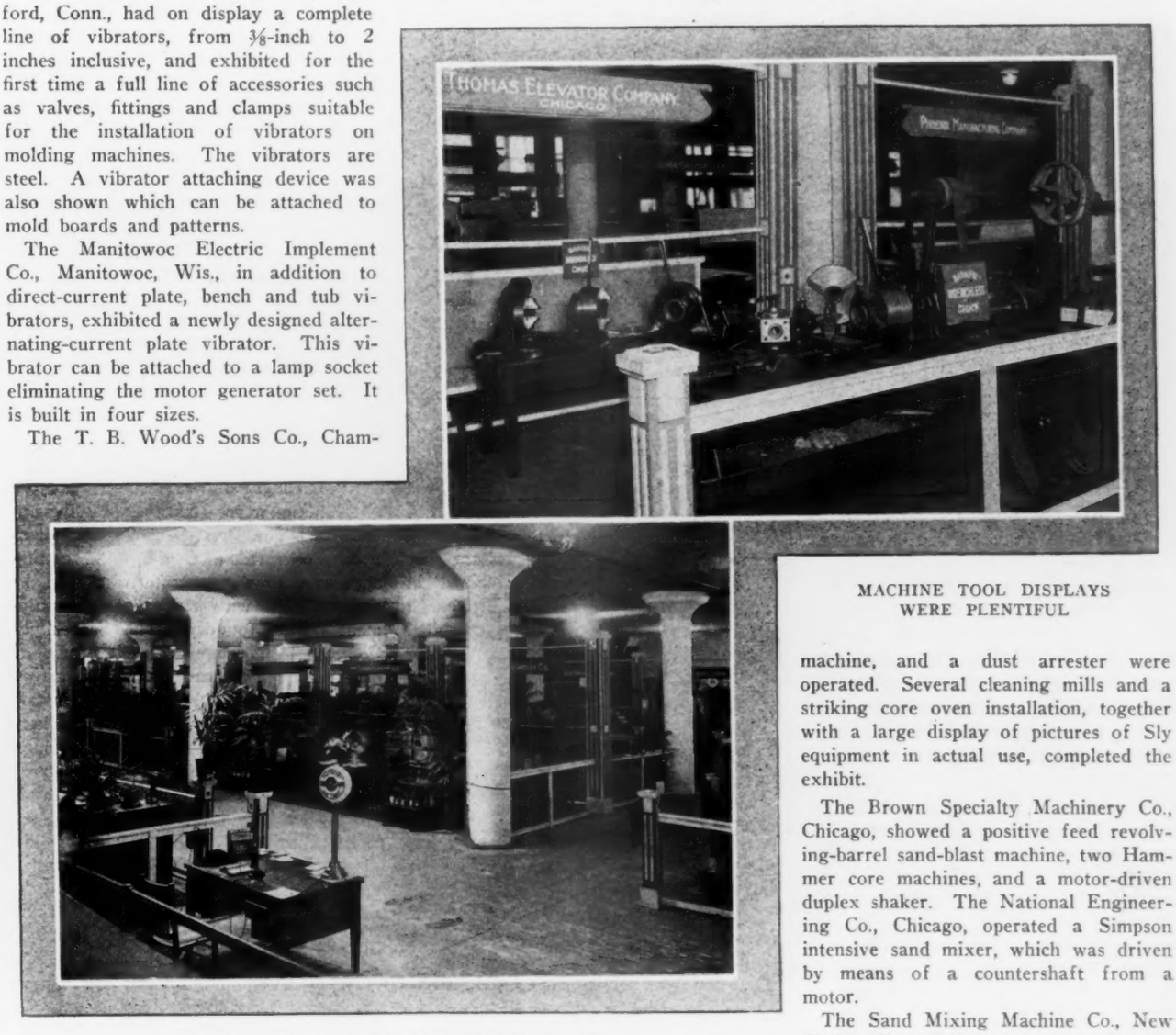
Direct pressure sand-blast equipment, including barrel and revolving-table types with auxiliary apparatus, was exhibited by the Mott Sand Blast Mfg. Co., Chicago. The New Haven Sand Blast Co., New Haven, Conn., showed a number of sand blast barrels, with a dust arrester and other equipment in actual operation. Five sand-blast machines enroute to prospective purchasers, but temporarily held at the Coliseum during the convention, formed the exhibit of the Pangborn Corporation, Hagerstown, Md. The Hoevel Mfg. Corporation, New York, manufacturer of sand-blast equipment provided a rest room for visiting foundrymen. The American Foundry Equipment Co., New York, exhibited three sizes of sand-blast tumbling barrels, one rotary table sand-blast room and a sand-blast tank outfit.

The W. W. Sly Mfg. Co., Cleveland, exhibited a complete line of foundry equipment. The sand-blast apparatus included machines representing the largest and smallest sizes made by this company. A rotary table sand-blast machine, and a dust arrester were operated. Several cleaning mills and a striking core oven installation, together with a large display of pictures of Sly equipment in actual use, completed the exhibit.

The Brown Specialty Machinery Co., Chicago, showed a positive feed revolving-barrel sand-blast machine, two Hammer core machines, and a motor-driven duplex shaker. The National Engineering Co., Chicago, operated a Simpson intensive sand mixer, which was driven by means of a countershaft from a motor.

The Sand Mixing Machine Co., New York, displayed its auto sand-cutter which has been entirely redesigned and improved since last exhibited. Photographs of sand-mixing and preparing machinery were shown by the Standard Sand & Machine Co., Cleveland. The Macleod Co., Cincinnati, exhibited two types of revolving barrel sand-blast machines, oil burners, acetylene generators, etc.

The Hauck Mfg. Co., Brooklyn, N. Y., displayed a large variety of hand-pumps and compressed air oil burners, Soft metal furnaces, kerosene torches, rivet heaters and outfits for starting core



A SECTION OF THE MAIN EXHIBIT HALL

MACHINE TOOL DISPLAYS WERE PLENTIFUL

ovens were also shown. The Mahr Mfg. Co., Minneapolis, Minn., exhibited an oil burning rivet forge, foundry torches, and a number of large torches for steel car repair work.

The Sensand-Arens process of casting pipe by centrifugal force in permanent molds was indicated by means of a machine in which pipe has been made by this process. It is claimed that a 4-inch x 4-foot pipe having a tensile strength of 46,300 pounds per square inch can be cast in this machine in 20 seconds. The Companhia Brasileira De Metallurgia, San Paula, Brazil, is now using this type of machine and a company is being formed to utilize the patent in the United States.

The Foundry Equipment Co., Cleveland, showed a stationary brick core oven with roller drawers, a sprue cutter, a hand squeezer, an aluminum furnace, and miscellaneous foundry equipment. A feature of this exhibit was a crucible-lifting mechanism which is said to eliminate much of the danger incident to the handling of crucibles with tongs.

The exhibit of the Wadsworth Core Machine & Equipment Co., Akron, O., consisted of several types of core machines, a sand-mixing and compounding mill, a large variety of steel core trays and bottom plates. The exhibit was in reality a complete core room in operation.

A motor-driven automatic coremaking machine in operation was shown by Wm. Demmler & Bros., Kewanee, Ill. The machine is capable of filling eight core boxes per minute, and is said to require less than one horsepower and to consume about 12 cubic feet of air per minute.

Sand riddles embracing a number of distinct types, were exhibited by the Great Western Mfg. Co., Leavenworth, Kas. A gyratory riddle equipped with a rectanguar no-dump sieve for continuous riddling was one of the features of this display. Sand riddles were also exhibited by the Champion Foundry Machinery Co., Chicago, and the Hill & Griffith Co., Cincinnati. The Combs gyratory motor-driven riddle was on exhibition at a number of booths in the Coliseum and in the annex.

Core Binders

The manufacturers of core binders prepared unusually interesting exhibits for this convention. The American Gum Products Co., New York, featured goulac, a core binder, and exhibited a number of cores in which this binder was used. Castings made from molds containing these cores also were shown. Glutrin, a core binder manufactured by the Robeson Process Co., New York, was interestingly exhibited by means of a display of cores in which the binder was used. An intricate core for an automobile engine attracted considerable attention to this exhibit.

Frederic B. Stevens, Detroit, exhibited a line of foundry facings, core compounds, etc. Steel ladle bowls and castband shanks were also displayed. E. J. Woodison & Co., Detroit, had an exhibit in which a wide variety of foundry equipment was displayed. Buffing compounds, L. & A. electric vibrators, no-wedge clamps, core binders, core oils, and a Riehle core testing machine were among the products shown. Other exhibitors of core compounds and foundry facings included the Hill-Brunner Supply Co., Cincinnati; the Holland Core Oil Co.; the Werner G. Smith Co., Cleveland; the Cataract Refining & Mfg. Co., Buffalo, N. Y.; the Smith Facing & Supply Co., Cleveland; the J. S. McCormick Co., Pittsburgh, and the Hill & Griffith Co., Cincinnati.

Exhibits of Sand

Attractive booths were maintained by manufacturers of various kinds of molding, facing and sand-blast sand. The Interstate Sand Co. showed Brown's parting sand and molding sands for iron and steel castings. The J. W. Paxson Co., Philadelphia, displayed gravel and molding sand and the Portage Silica Co., Youngstown, O., featured sand-blast sand, molding sand, and silica products. The United States Silica Co., Chicago, showed pictures of castings cleaned by a special sand-blast sand obtained in the state of Illinois. The Pittsburgh Crushed Steel Co., Pittsburgh, exhibited angular grit and a hardener or facing mixture for concrete floors. Molding sand was exhibited by the Gordon Sand Co., Conneaut, O., and the Superior Sand Co., Cleveland.

It is doubtful if in previous years the displays of safety appliances, particularly goggles and wearing apparel, equaled those of the 1916 convention. The variety of products intended to prevent accidents in the foundry has increased tremendously in recent years and from the exhibits at the Coliseum, it would seem that the molder who receives injuries after being properly equipped with the articles now available, can lay the blame only to his own carelessness. Exhibits of various types of goggles and eye shields for chipping, welding, cutting, etc., were provided by the Chicago Eye Shield Co., Chicago; F. A. Hardy & Co., Chicago; the Julius King Optical Co., New York, and Strong, Kennard & Nutt Co., Cleveland. The Multi-Metal Separating Screen Co., New York, exhibited sand-blast helmets and the R. P. Smith Sons Co., Chicago, showed a line of safety shoes. The Life Saving Devices Co., Chicago, displayed a number of lungmotors, which are used for reviving persons overcome by asphyxiation, electric shock, drowning, etc. A complete line of leggings, helmets, gloves, aprons and safety garments was shown by Wheeler & Holcomb, Chicago. An interesting exhibit was maintained by the American Foundrymen's Association. Bulletins and pictures issued by the National Safety Council were displayed.

The exhibits of welding apparatus indicated that the manufacturers of these appliances were determined to attract their share of the attention of visiting foundrymen. Practically all of the firms maintaining exhibits displayed their goods by actually demonstrating them in operation.

The Davis Bournonville Co., Jersey City, N. J., demonstrated oxy-acetylene and oxy-hydrogen welding and cutting apparatus adapted to foundry work. Two of the features attracting much attention were the radiograph and oxygraph which make it possible to cut billets, plates, etc., of considerable size accurately and with a small amount of waste. A great variety of regulating valves, generators and miscellaneous equipment was also shown.

The Oxweld-Acetylene Co., Chicago, had an operating exhibit including a complete oxy-acetylene welding and cutting outfit. Heads and sprues were cut from castings and several unique jobs of welding were performed by demonstrators. The Prest-O-Lite Co., Indianapolis, operated a welding and cutting apparatus to demonstrate what can be accomplished with this type of equipment in the foundry. The Searchlight Co., Chicago, demonstrated the use of oxy-acetylene apparatus in repairing broken castings and in welding metals of all kinds. The Goldschmidt Thermit Co., New York, showed samples of various alloys, including thermit, ferrosilicon, etc. Pictures of several large thermit welds were displayed. The Imperial Brass Mfg. Co., Chicago, exhibited welding, cutting and decarbonizing appliances.

Foundry Metals

Ingot metal was displayed by an unusually large number of exhibitors this year. Most of the manufacturers showed castings made from their metals, and in a number of cases the exhibits were extremely attractive. Various foundry metals were displayed by the Ajax Metal Co., Philadelphia; S. Birkenstein & Sons, Chicago; Benjamin Harris & Co., Chicago; the Lake Erie Smelting & Refining Co., Cleveland; the Michigan Smelting & Refining Co., Detroit; the Titanium Alloy Mfg. Co., Niagara Falls, N. Y., and White & Bro., Inc., Philadelphia.

The Alexander Bros. Lumber Co., Cleveland, exhibited water-cured white pine pattern and flask lumber, and the Thomas E. Coale Lumber Co., Philadel-

phia, showed Michigan white pine and California sugar pine pattern lumber.

The exhibit of Charles H. Besly & Co., Chicago, consisted of several grinders for the pattern shop and foundry. Patterns and castings which had been ground on these machines were displayed, and several of the grinders were operated to demonstrate the work that can be done on them. The Carborundum Co., Niagara Falls, N. Y., had an exhibit of grinding wheels, one of which was 78 inches in diameter, and had an 8-inch face.

Only a few manufacturers of building materials for foundries displayed their products. The booth of the Ayer & Lord Tie Co., Chicago, had a wood-block floor and a railing constructed of wood blocks. Pictures of wood-block floors in industrial plants were shown. The Jennison-Wright Co., Toledo, O., exhibited wood blocks of various shapes, and showed pictures of installations of this type of floor. The David Lupton's Sons Co., Philadelphia, showed samples of steel sash with special ventilating panels for industrial buildings.

The exhibit of the Monarch Engineering & Mfg. Co., Baltimore, consisted of portable, tilting and stationary furnaces for foundry metals and core ovens of various types for operation with oil, gas, coal or coke for fuel. A simplex furnace and a double-chamber furnace for melting brass and non-ferrous metals without crucibles, were features of the exhibit. The J. W. Paxson Co., Philadelphia, exhibited a model of a Paxson-Colliau cupola equipped with Zippler tuyeres. The Whiting Foundry Equipment Co., Harvey, Ill., manufacturer of foundry cranes, cupolas, etc., showed pictures of its products. The Snyder Electric Furnace Co., Chicago, presented drawings and photographs of its apparatus.

Coke and Pig Iron

The dealers in foundry coke, pig iron, etc., provided spacious rest rooms for visitors, and in many cases prepared attractive exhibits. Perhaps the most novel exhibit of the foundry show was that of Pickands, Brown & Co., Chicago, which consisted of a reproduction of Perry's flagship LAWRENCE, the hull of which was formed of Solvay coke. This display was especially appropriate in Cleveland, and the record of Pickands, Brown & Co. for preparing a timely exhibit for each foundry show was well maintained this year.

The exhibit of Rogers, Brown & Co., Cincinnati, occupied a spacious booth fitted up as a rest room, in which a number of samples of pig iron and coke were displayed

The Lehigh Coke Co., South Bethlehem, Pa., the Jamison Coal & Coke Co., Pittsburgh, and the Graceton Coke Co., Graceton, Pa., showed samples of coke and pictures of their ovens.

The Cleveland Blow Pipe & Mfg. Co., Cleveland, exhibited exhaust systems for machines which give off fumes or fine dust. An emery wheel stand and accompanying exhaust system were shown in operation. One of the interesting features of this exhibit was a shower bath of simple construction designed for use in industrial plants.

The Sterling Wheelbarrow Co., West Allis, Wis., exhibited circular and rectangular steel flasks and a number of types of wheelbarrows for the foundry. Other exhibits of equipment for foundries, pattern shops, etc., were maintained by the Armstrong Cork Co., Pittsburgh; the Beighlee Electric Co., Cleveland; the Buckeye Products Co., Cincinnati; the Cleveland Wire Spring Co., Cleveland; Chas. J. Clark, Chicago; the Joseph Dixon Crucible Co., Jersey City, N. J.; the Gibb Instrument Co., Pittsburgh; the Charles C. Kawin Co., Chicago; H. M. Lane, Detroit; the Lakewood Engineering Co., Lakewood, O.; the Moltrup Steel Products Co., Beaver Falls, Pa.; the United States Graphite Co., Saginaw, Mich.; and W. F. Stodder, Syracuse, N. Y.

FLORAL DISPLAYS ADDED TO THE BEAUTY OF THE SHOW

One of the outstanding features of the machine tool exhibits was the emphasis tool builders laid on production. Tools today are built to utilize every ounce of available power and are designed so as to produce the best possible results in the least possible time. Such has been the effect of the past year's developments, and the tools on display in the Coliseum embodied many new features which made them desirable to the high-speed manufacturer.

The Amalgamated Machinery Corporation, Chicago, showed one of its shell boring and inside finishing machines, and this tool was one of the largest single machines on display. This machine includes several heavy castings,

for the production of which foundrymen were requested to submit proposals. The Warner & Swasey Co., Cleveland, exhibited two semi-automatic lathes, one hollow hexagon turret lathe and one No. 4 universal screw machine. Since the element of time has become such an important factor in modern manufacturing plants, recent developments in the design of Barker wrenchless quick-acting chucks were of interest. These chucks are manufactured by the Thomas Elevator Co., Chicago, and are so made that removal of the work from the chuck may be accomplished without stopping the lathe. The Phoenix Mfg. Co. Eau Claire, Wis., exhibited a complete line of turret lathe heads.

The Cincinnati Pulley Mfg. Co., Cincinnati had an interesting display of high-speed single and multiple-spindle drills. The Sipp Machine Co., Paterson, N. J., showed two quick-change, sensitive drill presses. These tools are built with from one to eight spindles.

The Lees-Bradner Co., Cleveland, exhibited two machines, including a gear cutter of unusual design and a thread milling machine. The Lucas Machine Tool Co., Cleveland, displayed a 50-ton forcing press for straightening malleable castings.

The Excelsior Tool & Machine Co., East St. Louis, Ill., exhibited two automatic polishing machines which were in operation throughout the week.

The Norton Co., Worcester, Mass., and the Gardner Machine Co., Beloit, Wis., each had a complete exhibit of machines for use in foundry cleaning rooms. The Gardner company was delayed in finishing some of the machines which were wanted for the exhibition and found it necessary to ship about 29,000 pounds of tools from Beloit, Wis., by express. The Norton company displayed a full line of grinding wheels for foundry use. Both bench and floor types were shown.

The use of compressed air in foundries has experienced a rapid rise to popular favor, and the number of builders of air compressors and manufacturers of tools using air for power that exhibited their wares is conclusive proof that this method of transmitting power is fundamentally right. The Chicago Pneumatic Tool Co., Chicago, had an interesting display of air compressors, pneumatic grinders, pneumatic geared hoists and air hammers. This company also manufactures portable electric grinders and drills, and tools of this type were on display. The Cleveland Pneumatic Tool Co., Cleveland, had a striking display of its products. This company manufactures chipping hammers, riveting machines, portable air grinders and pneumatic sand rammers. Several new features are said to have been embodied in this company's hammers. Oscillating valve grinders and air, water and oil hose and connections were shown. The Curtis Pneumatic Machinery Co., St. Louis, had an interesting display including compressors, a pneumatically operated hoist and a reciprocating device which is said to render unusual service to the concern using equipment of this nature. The air compressors built by this company have an accurately controled oiling device for lubrication of the compressor cylinder. The Ingersoll-Rand Co., New York, showed a 329-foot close-coupled, motor-driven air compressor with a 60-inch x 4-foot receiver. This machine, as well as the varied display of portable pneumatic tools which comprised the exhibit, was in operation.

The Sullivan Machinery Co., Chicago, showed a large motor-driven angle compound compressor in operation. The Union Steam Pump Co., Battle Creek, Mich., had a very extensive display of air compressors for foundry and machine shop use. This exhibit was unusual in that the working parts of each machine were exposed to view through the use of glass walls, the parts being illuminated.

The Brown Hoisting Machinery Co., Cleveland, showed one of its hand traveling cranes, as well as complete tramrail equipment, switches, turntables and chain hoists. The Hayward Co., New York, had an interesting exhibit of motor clam shell buckets, two-line orange peel buckets and drag scraper buckets.

The Oliver Machinery Co., Grand Rapids, Mich., had a very extensive display of wood and metal working machinery. The exhibit of the Gisholt Machine Co., Madison, Wis., featuring the Periodograph as a means of obtaining accurate foundry costs, was a novel one. Various applications of the device were shown. The Felt & Tarrant Mfg. Co., Chicago, exhibited a number of adding and calculating machines.

The West Haven Mfg. Co., New Haven, Conn., showed 6-inch and 9-inch high-speed hack saws. E. C. Atkins & Co., Indianapolis, exhibited circular metal cutting saws as well as special hack saw blades and hack sawing machines. J. D. Wallace, Chicago, exhibited a bench planer equipped with flap and shutter guard. This tool was operated by a direct-connected motor attached to an ordinary electric light socket. Herman A. Holz, New York, had a Brinnel meter on display and tests for hardness were made every day. The Norma Co. of America had an interesting display of ball, thrust and roller bearings.

The General Electric Co., Schenectady, N. Y., had an interesting display of motors, arc welding equipment and mazda lamps. The Lincoln Electric Co., Cleveland, showed one of its motors operating under water. A 300-ampere arc welder also was displayed. The Electric Controller & Mfg. Co., Cleveland, exhibited a number of photographs of its products.

New Plant Nearly Completed

The new plant of the Superior Steel Castings Co., Benton Harbor, Mich., is nearing completion and the company shortly will be in position to make shipments of steel castings weighing from a few ounces to 12 tons. The main building, which has a floor area of 30,000 square feet, is served by a 20-ton electric traveling crane with a five-ton auxiliary hoist, and a 10-ton electric crane. Steel is made in a 12½-ton acid open-hearth furnace. The bench molding floors are located in a separate building, 36 x 100 feet. A large, car type annealing furnace has been installed and a cleaning department, which occupies one end of the main building, is equipped with floor and swinging grinders, a Pangborn sand-blast with dust arresters, oxweld torches, etc. The officers of the company follow: S. E. Doster, president; W. R. Gilmore, vice president and general manager, and C. A. Pratt, secretary and treasurer.

The Abingdon Sanitary Mfg. Co., Abingdon, Ill., will build a one-story foundry, 40 x 160 feet.

Irving A. Sibley Jr. has been appointed secretary and treasurer of the Decatur Malleable Iron Co., Decatur, Ill.

George M. Judd has been elected secretary of the American Brake Shoe & Foundry Co., New York, succeeding Henry C. Knox, resigned. Mr. Knox will continue as treasurer.

John A. Rathbone, a foundryman of wide experience and the inventor of the multiple molding machine which bears his name, has been appointed instructor in foundry practice by the Pratt Institute, Brooklyn, N. Y.

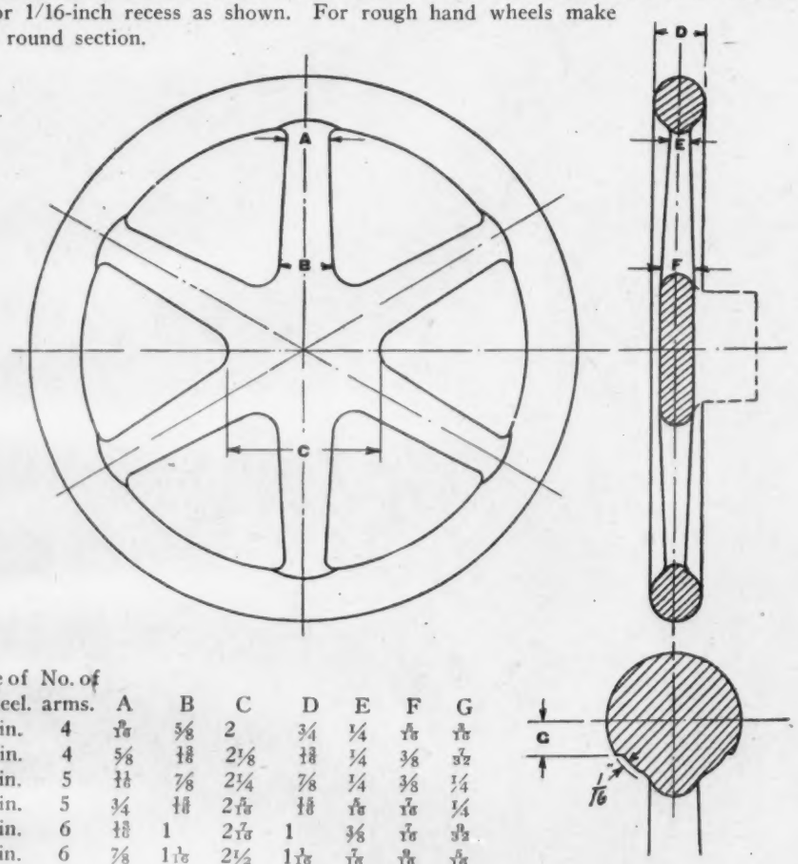
The Sterling Machine & Stamping Co., Wellington, O., manufacturer of kitchen ware and other aluminum castings, has added a gray iron foundry, 60 x 120 feet, which will be placed in operation early in October. A specialty will be made of light castings.

W. H. Burgess, formerly general superintendent of the International Malleable Iron Co., Ltd., Guelph, Ont., has been made vice president and manager of the company, following the resignation of P. D. Ivey, who has sold out his interest in the concern.

DIMENSIONS OF STANDARD HAND WHEELS.

By John Leafstrom

Make hubs loose and interchangeable to permit use of hubs of different lengths and diameters on either or both sides of the wheel. For hand wheels with finished rims allow for 1/16-inch recess as shown. For rough hand wheels make rim full round section.

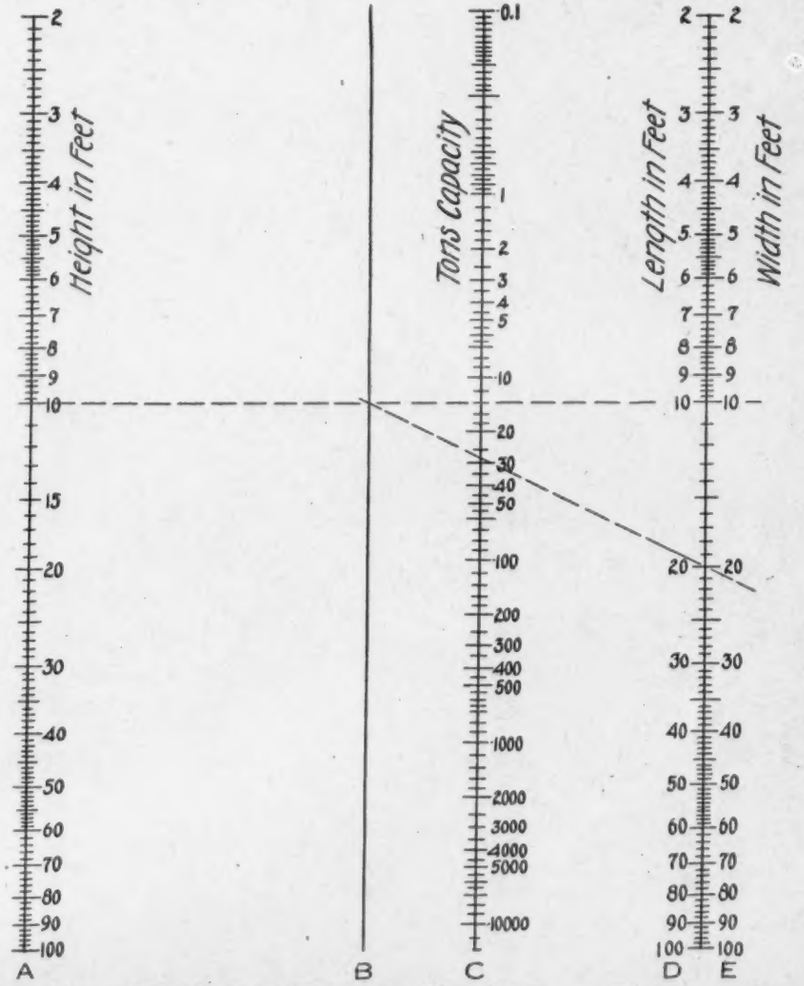


Size of wheel.	No. of arms.	A	B	C	D	E	F	G
5-in.	4	5/16	5/8	2	3/4	1/4	1/16	1/16
6-in.	4	5/8	13/16	2 1/8	13/16	1/4	3/8	3/32
7-in.	5	11/16	7/8	2 1/4	7/8	1/4	3/8	1/4
8-in.	5	3/4	15/16	2 5/16	15/16	5/16	7/16	1/4
9-in.	6	13/16	1	2 7/16	1	3/8	7/16	5/32
10-in.	6	7/8	1 1/16	2 1/2	1 1/16	7/16	9/16	5/16
11-in.	6	15/16	1 1/8	2 5/8	1 1/8	7/16	9/16	5/16
12-in.	6	1	1 3/16	3	1 1/4	1/2	5/8	11/32
14-in.	6	1 1/16	1 1/4	3 3/8	1 3/8	1/2	5/8	3/8
15-in.	6	1 1/8	1 5/16	4	1 7/16	1/2	5/8	3/8
16-in.	6	1 3/16	1 3/8	4 1/4	1 1/2	1/2	5/8	13/32
18-in.	6	1 1/4	1 1/2	4 1/4	1 1/2	9/16	11/16	7/16
20-in.	6	1 5/16	1 5/8	4 1/2	1 1/2	9/16	11/16	7/16

CAPACITY OF COKE BINS.

By N. G. Near

To determine the number of tons of coke in a rectangular bin lay a straight edge across columns *A* and *E* in the accompanying chart so as to connect the points representing the height and width of the bin. From the point where this line intersects the vertical line *B*, lay a straight edge to the point on column *D* representing the length of the bin. This line intersects column *C* at a point which represents the capacity in tons. The dashed lines show that a 10 x 10 x 20-foot bin will hold 28 tons of coke.



Note—This sheet may be cut into two sections, 5 x 7 inches, and may be readily bound in note-book form.

THE FOUNDRY DATA SHEET, OCTOBER, 1916

Payment will be made for all contributions on foundry and pattern shop practice suitable for publication

How to Gate and Head Steel Castings Properly

The Relation Between Gating and Heading and the Shrinkage of Castings—Gating Should not be Intrusted to the Molders

By Ralph D West

THE economical and practical production of steel castings depends largely upon the preparation of the mold and the subsequent behavior of the metal during the pouring and freezing periods. In order that the molten steel may enter the mold, a pouring hole or gate must be provided, so that the mold will receive the metal as rapidly as required, according to the size and section of the piece being made. The gate also should be arranged so as not to interfere in any way with the production of a perfect casting.

The steel foundryman must determine the location of the gate in the mold by his knowledge and practical experience, and must give due consideration to the problem of shrinkage. Molten steel in passing from the liquid to the solid form will shrink from 3/16-inch to ¼-inch per foot of length. Therefore, practically all steel castings must be provided with some form of a reservoir to feed or take-up the shrinkage as it develops, so as to form a solid casting. This feeder or reservoir is commonly called a head. Green sand has a natural bond, and presents a greater chilling action to the liquid steel than dry sand, thus requiring in most cases a lesser percentage of metal in the head to feed the casting or to offset the shrinkage. It is understood that a dry-sand mold is simply a green-sand mold with a special facing, placed in an oven and dried or baked so as to eliminate the moisture, thus presenting a better surface to the molten steel for final results.

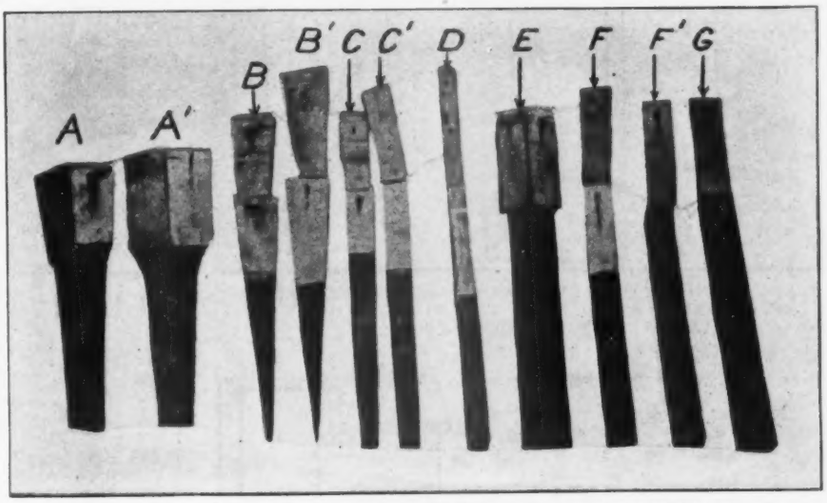


FIG. 1—TEST BARS WITHOUT HEADS SHOWING SHRINKAGE

The Effect of Shrinkage

The shrinkage problem varies according to the shape and form of the casting as well as according to its sections. The standard forms of test bars shown in Fig. 3 illustrate the various shrinkage phenomena. The bars were molded in both green and dry sand and were poured from the top, without any gate and with no extra head. This is commonly known as an open mold, poured through the head and cast on end. Test bars, *A*, *B*, *C*, etc., Fig. 1, were cast in dry sand, and test bars *A'*, *B'*, *C'*, etc., were cast in green sand. There is a very strong contrast in the shrinkage cavity due to the different chilling or cooling effects of the molds. Note especially test bars *C* and *C'*. This is a common section and one that can in most cases be cast without a feeding head. The green sand mold shows practically a solid bar. Taking the various sizes of test bars, it becomes very evident that any section 1-inch or over requires some form or means of feeding to avoid porosity. It is also true that all shrinkage remains in the top of properly molded and poured castings.

The next set of tests, shown in Figs. 2, 6 and 7, covers standard test bars with different forms of heads or feeders, such as may be found in all steel foundries. Fig. 2 shows bars cast in dry sand and Fig. 7 those cast in green sand. Fig. 4 gives the dimensions of the heads and of the test bar, which is shown at *M*. This bar contains 32 cubic inches. Head *A"*, Fig. 4, contains 28 cubic inches; *B"* and *D"*, 10 cubic inches; *C"*, 12½ cubic inches; *E"*, 20¼ cubic inches, and *F"*, 9 cubic inches. As in the previous test, the green sand bars are easily distinguished from the dry sand bars, showing greater solidity. Only bars *A* and *B* can be considered to represent practical safe conditions. No doubt bar *A* has an excessive head and can be reduced so

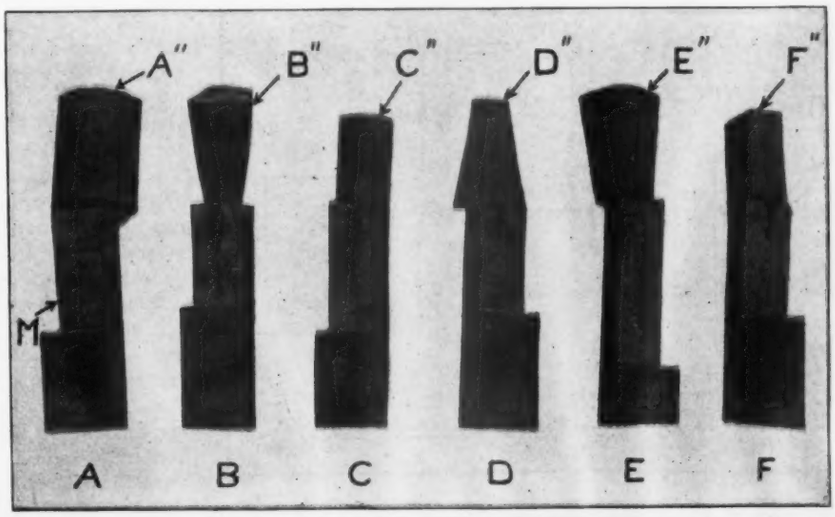


FIG. 2—TEST BARS WITH VARIOUS FORMS OF HEADS CAST IN DRY SAND

Presented at the Cleveland meeting of the American Foundrymen's Association, Sept. 11-15, 1916. The author is president of the West Steel Casting Co., Cleveland.

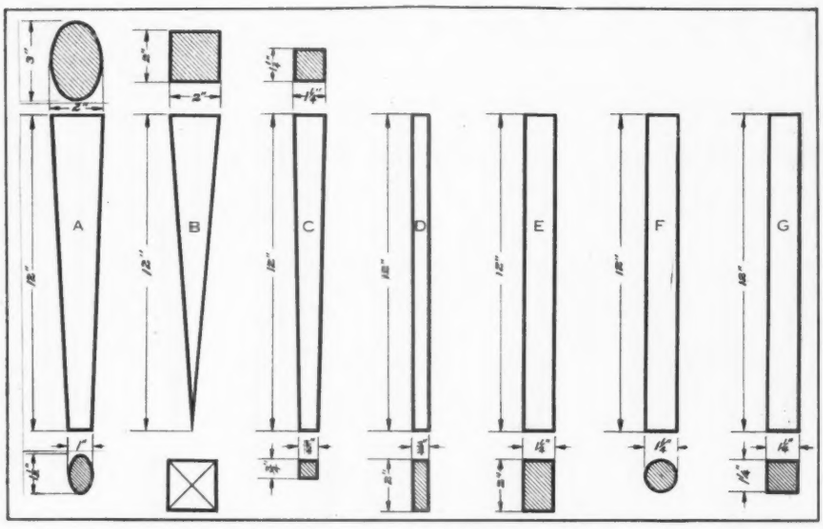


FIG. 3—DIAGRAM SHOWING SIZES OF TEST BARS USED. THE BARS OF THESE DIMENSIONS WERE POURED FROM THE TOP, WITHOUT ANY GATE AND WITH NO EXTRA HEAD

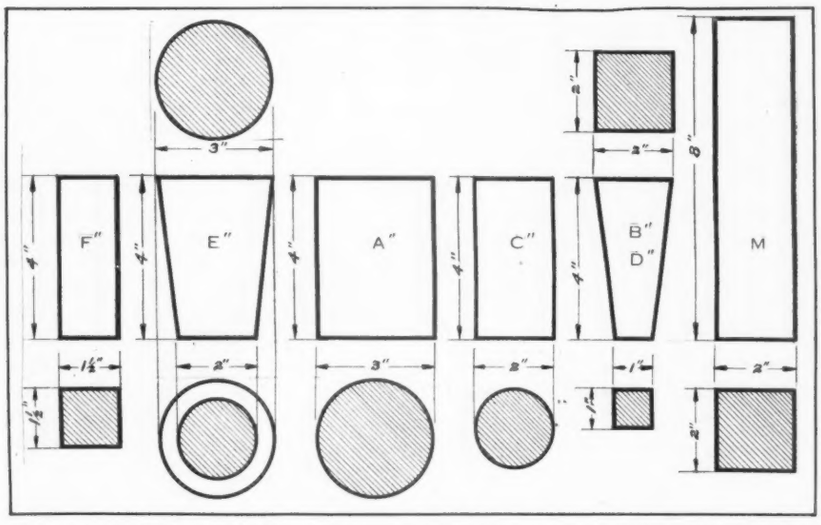


FIG. 4—DIAGRAM OF SHRINK HEADS SHOWING SIZES—DIMENSIONS OF TEST BAR ARE SHOWN AT *M*. HEAD *A"* CONTAINS 28 CUBIC INCHES; *B"* AND *D"*, 10 CUBIC INCHES; *C"*, 12½ CUBIC INCHES; *E"* 20¼ CUBIC INHES, AND *F"*, 9 CUBIC INCHES

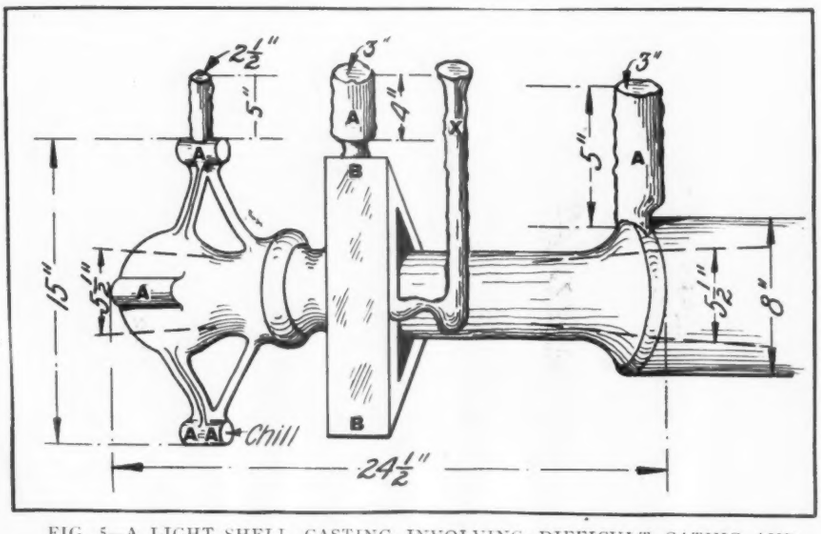


FIG. 5—A LIGHT SHELL CASTING INVOLVING DIFFICULT GATING AND HEADING. CARE MUST BE TAKEN TO ADEQUATELY FEED THE LIGHT EXTENSIONS TO AVOID SHRINKAGE SPOTS

that bar *E* might be called the proper standard for a head. In this bar the ratio of head to casting is as 20 cubic inches is to 32 cubic inches. There is 38 per cent steel in the head and 62 per cent in the casting. If the above test can be accepted as an average standard, it is possible to compare the daily cast report against the daily shipments of castings, obtaining either good or bad returns according to the class of work produced. The question of loss of steel in gates, which becomes excessive to the producer of small castings, must also be considered.

In a foundry where an ordinary steel molder is given a pattern with simple instructions to head and gate the casting, considerable trouble is experienced due to defective work. He may have a gate at hand that will answer, for the main point of importance is where the

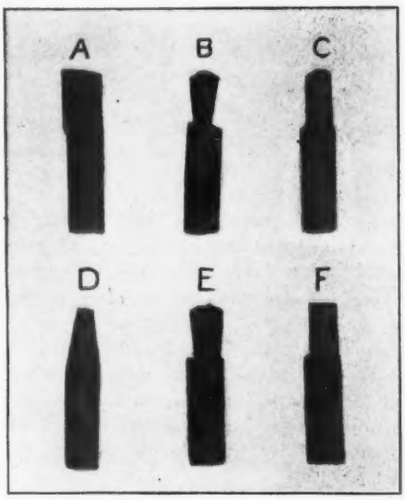


FIG. 6—TEST BARS WITH SIX DIFFERENT FORMS OF HEADS

gate or its extremity, the sprue, attaches to the casting. This point can be properly sized and cut with the molder's tools, while the upper part must be large enough to admit the steel properly. It is often too large, resulting in considerable loss of metal. The head in many cases is peculiar to the pattern at hand and to obtain the best results ought to be cut and shaped before handing pattern to the molder.

In some foundries standard gates are prepared for every job that may come up. The heading, however, is left open to the molder. This method of procedure is not always practical, but when it can be followed the decrease in the percentage of bad or defective work will soon pay the expense of such a department. It is to the foundry what a tool room or jig department is to the machine shop. There is no question but that an efficient molder can rapidly improve his knowledge of heading and gating by making it his special work, thus relieving the foreman of this im-

portant duty. This gives a tone to the foundry system that goes a long way toward accuracy and the repetition of good results. The problem of gating and heading would be very simple if all castings presented regular standard forms, but, as is well known, the engineer of today must build efficient machines, and this involves little consideration for the foundryman. It is his problem alone to produce solid, perfect castings from a network of confused shapes and sections run together, light to heavy and curved to straight and at any angle. A number of examples of practical gating methods will now be considered.

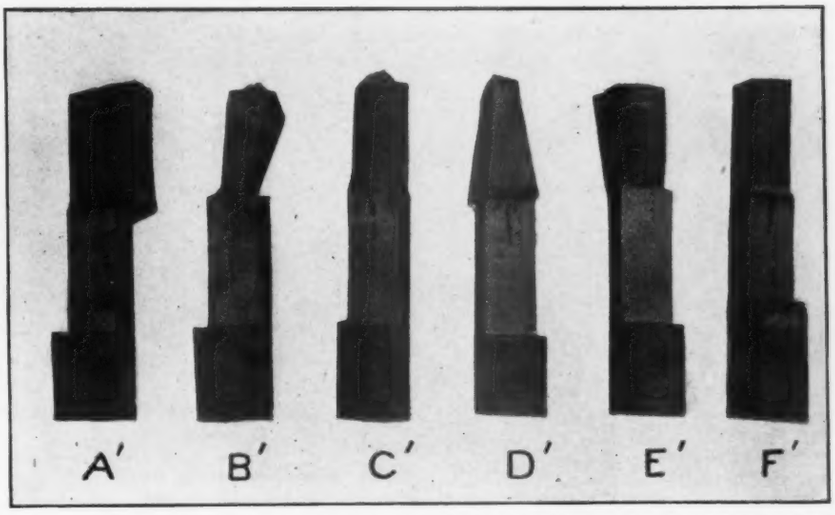
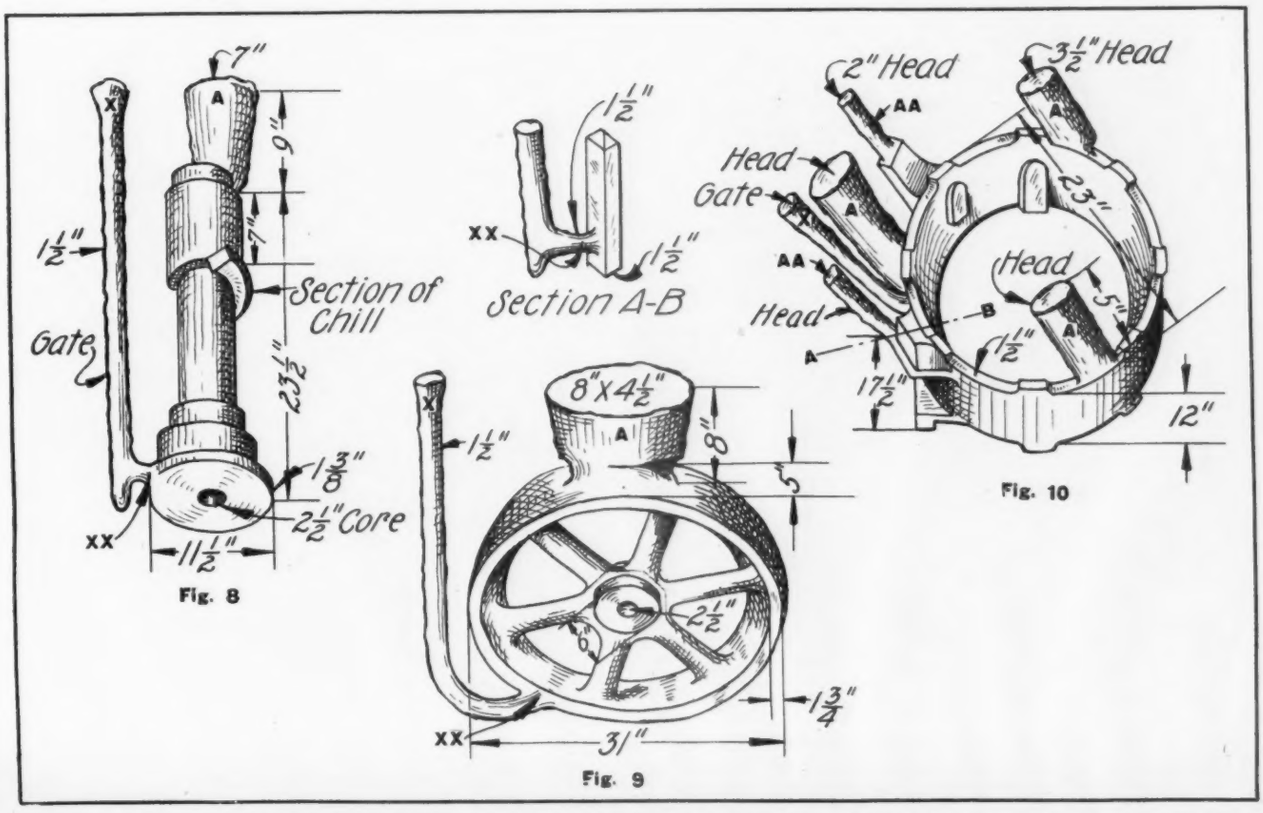


FIG. 7—TEST BARS SIMILAR TO THOSE SHOWN IN FIG. 2 CAST IN GREEN SAND

The casting shown in Fig. 8 is a cylindrical casting which is to be finished all over. The top under the head forms a cut pinion, the bottom plate of the casting being a friction surface for a brake. The form of the casting is simple, but as a perfect, solid job must be obtained, it is preferable to cast it on end with a large head on top. The gate or sprue must be run to the bottom of the mold so as to give clean steel in the finished job.

Two practical points must be observed in forming the mold. First, in cutting the sprue, the area of the cross section at *XX* must be made smaller than the cross section of the casting, otherwise when the gate freezes, it will pull a piece out of the casting at the joint. Secondly, the molder must be careful to remove the sand around the head before the casting sets, so as to avoid a check or crack in the main body. One way to avoid such losses is to place a chill ring around the pattern at the point shown. This method will answer in some cases, but not in all. The casting illustrated being heavy at the bottom, will require feeding, therefore, placing a chill at the middle would not allow the head to feed the bottom. This would leave shrinkage in the lower end. If the middle section of such a casting is too light to feed the bottom, the foundryman must use his judgment in regard to using two large heads, one on each end. In reply to three letters of inquiry, two foundrymen outlined methods of casting on end, as described, and a third suggested that the pattern be placed in a horizontal position, with a head at either end.

Fig. 10 shows a standard form of circular shell casting, in this case designed for a magnet frame. Experience has taught that it is advisable to cast, as illustrated, with three or four heads on the rim, according to the section of the casting, and to gate between the feet with a bottom gate. The main points to be considered about such cast-



FIGS. 8, 9 AND 10—METHODS OF GATING A SIMPLE CYLINDRICAL CASTING, A GEAR BLANK, AND A MAGNET FRAME

FIG. 11—A WASTEFUL METHOD OF HEADING A WHEEL

ings are first, to properly feed the heavy sections called pole pieces, and second, to gate so as to distribute the metal as evenly as possible around the circle. The poles, if concealed below the top section, will have to be chilled either by nailing or placing iron chills in the rear of the mold, held in place in the sand form.

The gate should be located as near the bottom as possible and so directed as not to cut or wash the inner surface of the core when entering the mold. Also, caution is necessary at the point of connection marked *XX*, as outlined in the discussion of Fig. 8. Particular attention is necessary in all circular forms to relieve the casting of strains, by digging out the center core as soon as the metal is set. Some foundrymen pour water into the center of large cores to soften them at once. This is known as a water gate.

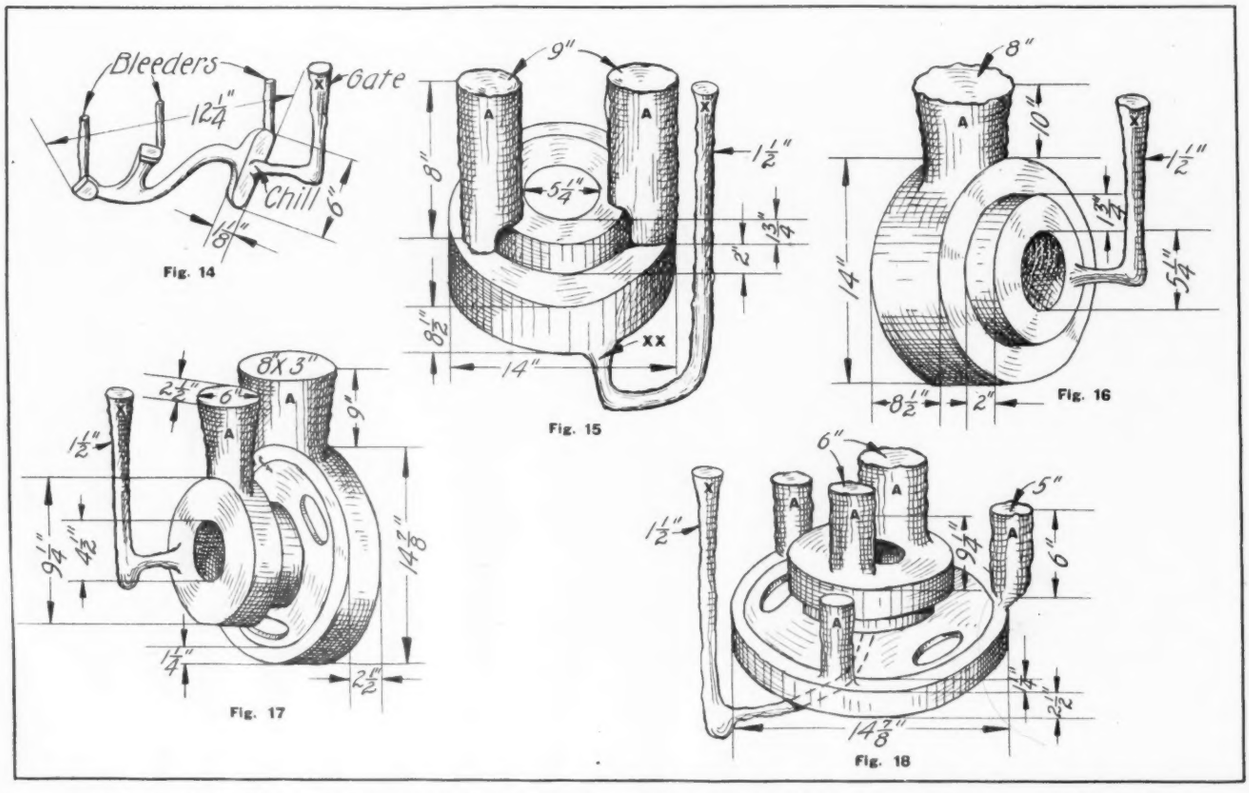
Fig. 5 illustrates a light shell casting having extensions in the form of legs terminating in bosses. They must be

FIG. 12—WHEEL WITH SHRINK HEADS THAT ARE TOO HEAVY

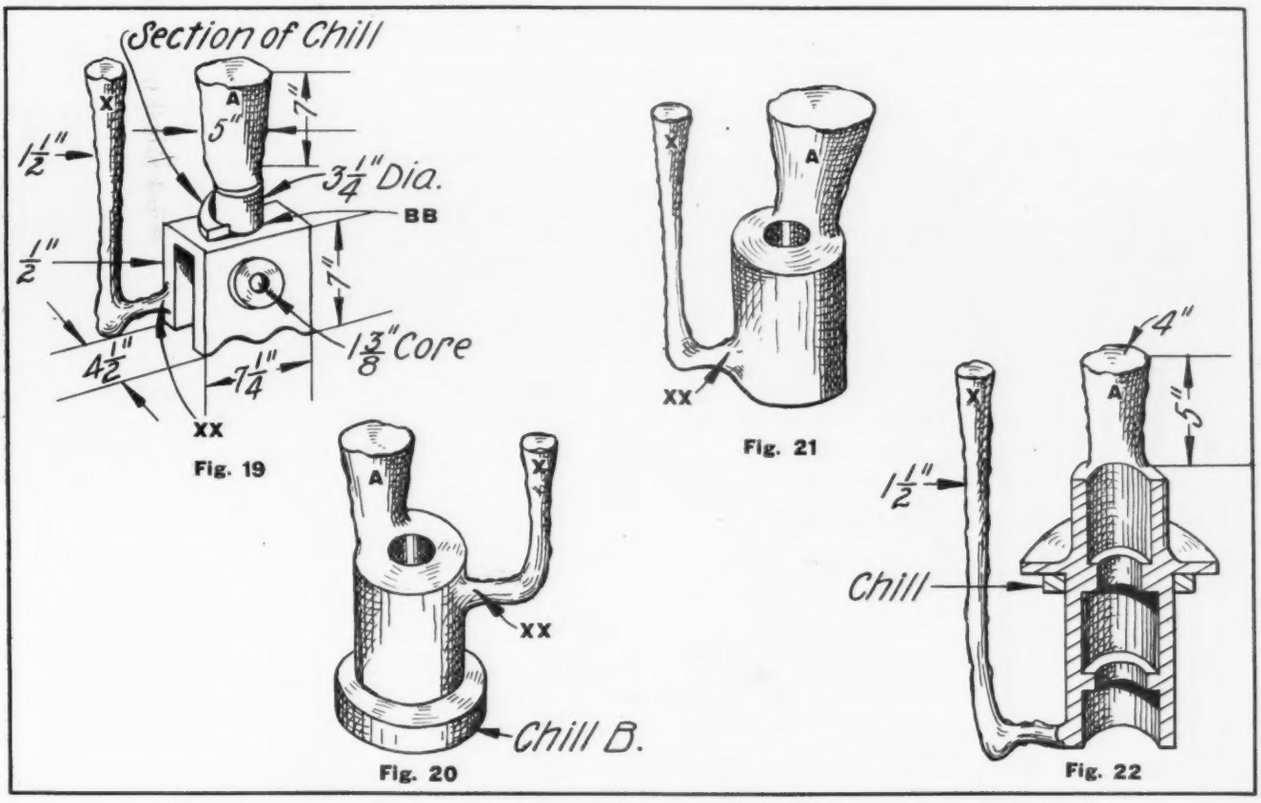
FIG. 13—A SATISFACTORY METHOD OF HEADING A WHEEL

fed so as to avoid shrinkage spots. It is possible, when casting such light sections, to omit the necessary heads, providing simply a gate or entrance for steel at one end and an outlet or relief at the other end. The main point in such a casting is to core it so as to give a clean casting and to avoid stresses when the metal shrinks.

Fig. 9 shows a gear blank, a casting common to all foundries. It must be clean and solid with no dirt or shrinkage. At the plant of the West Steel Casting Co. a system of casting all gears on end, even as large as 4 feet in diameter, has been established. The



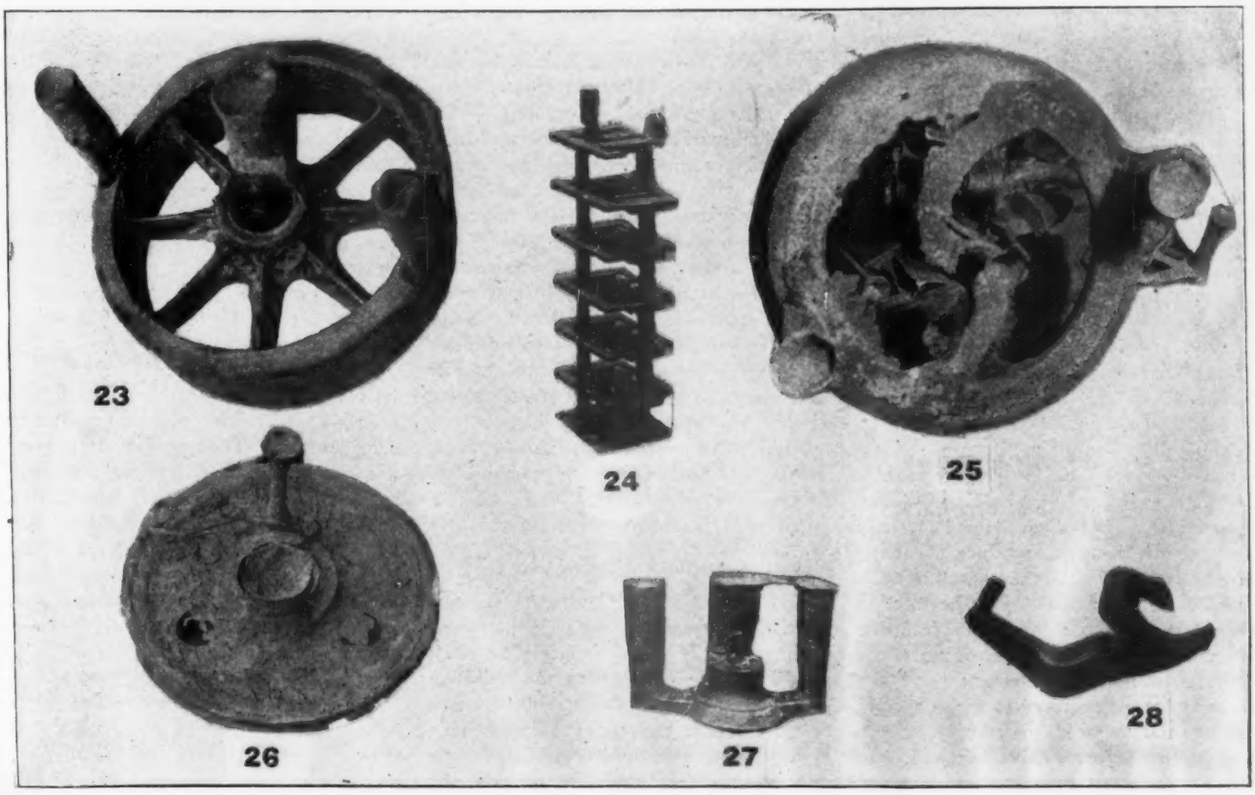
FIGS. 14, 15, 16, 17 AND 18—METHODS OF GATING A LEVER OR BRACKET CASTING, BULL PINIONS AND DOUBLE GEAR CASTINGS



FIGS. 19, 20, 21 AND 22—METHODS OF GATING A NUMBER OF TROUBLESOME CASTINGS

sketch clearly illustrates the method of molding which gives a clean, solid job. In the heading and gating of such a casting, cast on end, the shrinkage is troublesome and it is necessary to distribute the metal evenly so as to avoid all hot spots, causing checks.

In comparison with this method consider a gear cast flat with the four or five heads necessary to feed it, as shown in Fig. 12. What steel foundry can make a profit out of such waste of metal in heads or risers? Undoubtedly, the heads weigh twice as much as the casting. Communications received



FIGS. 23, 24, 25, 26, 27 AND 28—A NUMBER OF STEEL CASTINGS PROPERLY GATED AND HEADED

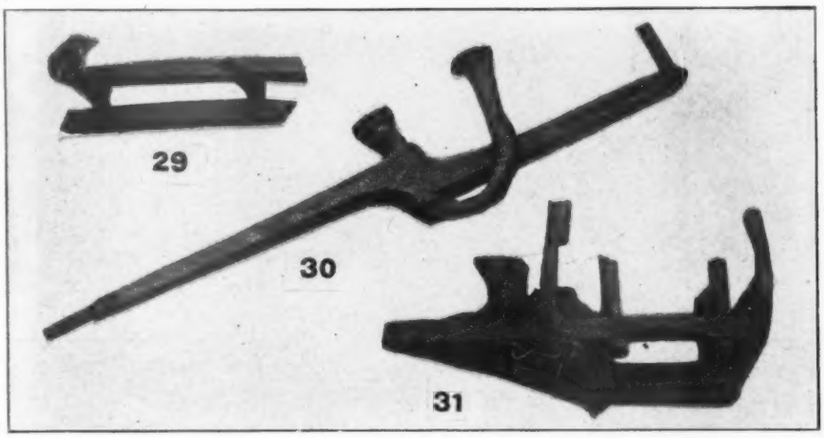
from three foundries, however, were two to one in favor of casting flat. Also consider the two different methods of gating shown in Figs. 11 and 13. The weight of the head on the casting shown in Fig. 13 is 66 pounds; those on the casting shown in Fig. 11 weigh 120 pounds. The latter has a bottom gate under the hub.

Fig. 14 shows a common form of lever or bracket casting, having a curved section with holding lugs. Such castings usually require caution in gating only so as to avoid checking when the metal shrinks. The heavier section or connection must be chilled and the ends relieved with pop heads, or whistles, simply to allow the gases to escape quickly. Figs. 15 and 16 show two methods of casting common bull pinions. The method shown in Fig. 15 is preferable, as it gives a clean casting when machined. It is easy to mold with a minimum of labor and weight of metal in the heads necessary to feed the casting solid. The method shown in Fig. 16 not only requires more labor to form the casting, but requires greater skill to produce a clean casting when finished.

Figs. 17 and 18 show two methods of heading and gating what is known as a double gear. This form of casting is very troublesome as success in one part is at a sacrifice in the other. Experience has taught that the best results are obtained by the method shown in Fig. 17. This is equivalent to molding two independent gears, each being provided with feeding and cleaning head. With the method illustrated in Fig. 18 trouble will be experienced on account of shrinkage and dirt in some parts of the cut gears. The smaller amount of metal in the heads is a deciding point to the foundry in favor of the method shown in Fig. 17.

Fig. 19 represents a common form of casting having a bearing section connecting a ribbed or boxed section. It is often difficult to produce a casting which is solid at the base of the shoulder marked *BB*. If the section of *BB* is not large enough to feed the lower body, the foundryman must not hesitate to notify the engineer of the necessary stock required to make a solid casting, and to mold accordingly. Some foundrymen place chills around the shoulder *BB*, but this practice does not allow the head to feed metal under the chill and therefore results possibly in a weak finished casting.

Figs. 20 and 21 present two methods of casting heavy bodies in molds so as to eliminate shrinkage as much as possible. This refers to dry sand molds where the castings are finished all over. Fig. 20 shows a casting setting on a chill. It is gated at the top, the metal falling on the chill. This method allows the hot metal to flow directly into the head, requiring only a small amount of steel, possibly 20 per cent, to feed a solid casting. Fig. 21 shows a common method of molding such a casting, with a bottom gate and a large head on top.



FIGS. 29, 30 AND 31—THREE LIGHT STEEL CASTINGS REQUIRING CAREFUL GATING AND HEADING

Steel foundrymen all know that to get a solid casting by such plain methods requires at least as much weight in the heads as in castings.

Fig. 22 illustrates a standard collar or sleeve, a troublesome casting, used by many automobile builders. The shoulder marked "chill" has no direct way of feeding the metal above and at each end, being too light in section to feed the inside section. It, therefore, becomes necessary for the steel foundryman to use his best knowledge, and set all the metal evenly by placing chills at the under section, as shown. Solid, perfect steel castings are often produced by pouring the metal slowly, being sure that enough steel passes through the mold and into the head, the casting setting as the pouring finishes.

Fig. 23 illustrates one method of producing steel wheels. These may be gated either into the arms, ribs or hub.

Stack Molding

Fig. 24 shows a method used in some foundries for molding and pouring small castings. It is called multiple or stack molding. The gate enters the mold on the side, allowing the gases or riser to flow off at the opposite side. This system is troublesome, especially when only one gate is used, as the confined gases will not allow the steel to fill the bottom molds.

Fig. 25 shows a drum or method of casting a plain flange or circular ring. Two light heads on the rim and an S-gate in the center are required.

Fig. 26 represents what is known as a sheave wheel. The outer rims of such wheels are usually of light construction with a heavy hub. Therefore, it becomes necessary to pour the molten steel rapidly into the mold, allowing full outlet for all gases formed. A bottom gate is provided on the hub.

Fig. 27 shows a small bevel gear cast with two side heads and one top head. This is a troublesome small casting to handle and the side heads, while not accepted as efficient, seem to answer the purpose. Fig. 28 shows method of casting a small job, using a gate as a feeding head with a side riser connecting a heavy section. Fig. 29 indicates a method of molding and casting small plain jobs, readily mounted on boards for rapid production. Large sprues hold the castings together so as to feed them properly.

Fig. 30 represents a method of handling long, thin castings. It is very necessary in such work that all strain be removed at once from the casting. Therefore, no gates or heads must be allowed to prevent the casting from shrinking.

Fig. 31 indicates the amount of labor which must be expended on some jobs to produce solid castings, when they are made in jobbing shops. A head must be placed on every boss to insure a solid casting. The chill nails placed in the bottom bosses to assist solidity are clearly illustrated.

There are many more forms of castings which might be described, but the foregoing will offer sufficient points for consideration. Today steel foundrymen are more or less ignorant of their associates' practices. The gate must be opened up in order to obtain more knowledge. This knowledge will lead foundrymen on to learn more, and through learning they can obtain some wisdom. Thus a theory in relation to practice may be developed.

The demand for antimony has stimulated the development of Alaskan deposits. Ore to the value of about $74,000 was mined and shipped during 1915.

Foundrymen Discuss New Safety Code Features

Provisions Drawn up by A. F. A. Committee on Safety and Sanitation Fully Cover Problems Involved in the Safe Operation of Casting Plants

THE "Safety First" propaganda which was started with such determination only a few years ago has long since ceased to be a propaganda to the modern foundryman. It is now a prosaic, daily affair. No other branch of the metal working trades has given more thought to the subject of safety for its employes than the foundry industry. The value of this concerted effort on the part of foundrymen is best measured by the tremendous decrease in fatalities and accidents in foundries throughout the country.

But the ultimate goal has not been reached. The committee on safety and sanitation, American Foundrymen's Association, has issued a proposed safety code which, when adopted, will stand as a model of excellence. The committee which met at Rochester, N. Y., July 20 and 21, was composed of a particularly representative body of men, among whom were the following: Victor T. Noonan, chairman, Industrial Commission of Ohio, Columbus, O.; F. H. Elam, American Steel Foundries, Chicago; George B. Koch, Pennsylvania railroad, Altoona, Pa.; E. B. Morgan, Norton Co., Worcester, Mass.; Richard Moldenke, Watchung, N. J.; Thomas J. Soults, Sill Stove Works, Rochester, N. Y.; C. E. Pettibone, Pickands, Mather & Co., Cleveland, and Ralph H. West, secretary, West Steel Casting Co., Cleveland.

In presenting the proposed code, the members of the committee urged its unqualified adoption. The provisions are as follows:

Rule A—Definition

Section 1.—A "foundry" shall mean a place where any metal, alloy or composition is melted and poured into molds for the making of castings.

Rule B—Entrances

Section 1.—The term "entrances" shall mean passages for common use provided for employes during working hours, between the foundry and open air.

Section 2.—Entrances to foundries shall be protected by a covered vestibule or its equivalent, which shall be so constructed as to eliminate drafts and of such dimensions as to answer ordinary purposes, such as the passage of wheelbarrows, trucks, and small industrial cars. This rule shall not apply to entrances used for railroad or industrial cars handled by locomotives or motors, or for traveling cranes, horse-drawn vehicles or automobiles; these entrances may remain open for such time as is necessary for the ingress and egress of such cars, trucks and cranes, horse-drawn vehicles or automobiles. No locomotive shall be permitted to remain inside the foundry during the loading or unloading of the cars.

Rule C—Gangways

Section 1.—The term "gangways" shall mean well defined passageways dividing the working floors of foundries, but not the spaces between molds.

Section 2.—Gangways other than those for carrying molten metal shall be of sufficient width and properly illuminated to safely allow the passage of men and materials. They shall be kept free from obstruction at all times.

Section 3.—Main gangways where metal is carried by hand or buggy shall be of sufficient width to allow the passage of two ladles going in opposite directions, with an additional side clearance of six (6) inches.

Section 4.—Main gangways for crane ladles shall be wide enough to allow a clearance of eighteen (18) inches on each side of the largest ladle used, except in such cases where ladles are carried with a clearance of at least 6 feet above the floor.

Rule D—Aisles

Section 1.—Spaces between molds shall be divided into three classes, which shall be known as "hand-ladle" aisles, "buggy-ladle" aisles and "crane-ladle" aisles.

Section 2.—Hand-ladle aisles—when a ladle is carried by one (1) man—shall be of sufficient width to allow two (2) men to pass.

Section 3.—Hand-ladle aisles—when ladles are carried by more than two (2) men—shall be wide enough to allow two (2) men to walk abreast, with an additional total clearance of six (6) inches.

Section 4.—Buggy-ladle aisles shall be sufficient width to accommodate the ladle with a clearance of six (6) inches on each side.

Section 5.—Crane-ladle aisles—leading from the molds to gangway—shall be of sufficient width to permit the safe ingress and egress of employes and safe use of ladles.

Section 6.—During the progress of casting, every gangway or aisle shall be kept entirely free from pools of water or obstruction of any nature. Every gangway where industrial tracks are used shall be constructed of a hard material of substantial character, and the top of the rails shall be flush with the floor.

Rule E—Ventilation

Removal of Smoke, Steam, Gases and Dust

Section 1.—Every foundry shall be so ventilated during working hours that smoke, gases, fumes, or dust injurious to the health of employes shall, as far as practicable, be rendered harmless by means of natural circulation of air, or by ventilating hoods, fans or other effective devices.

Section 2.—Where the operation of drying ladles causes fumes or gases within the foundry, ventilating hoods shall be provided to remove such fumes or gases.

Section 3.—All ovens from which fumes or gases escape shall be provided with hoods of sufficient capacity to remove such fumes and gases.

Section 4.—Foundries in which alloys containing zinc or aluminum are melted or poured shall have a minimum ceiling height of at least fourteen (14) feet. Every furnace shall be provided with ventilating apparatus to effectively remove all noxious fumes and gases. The ceilings of such foundries shall be at least six (6) feet above curb lines.

Rule F—Lighting

Section 1.—The light in every foundry shall be sufficient to provide safe entrance and exit of employes, and to carry on work safely during working hours.

Section 2.—When natural light is insufficient to properly light the foundry, artificial light of sufficient power shall be provided.

Section 3.—The continuous use of hand torches or other lamps that emit injurious smoke or gases is prohibited.

Rule G—Heating

Section 1.—The temperature in every foundry shall be maintained at not less than fifty (50) degrees Fahrenheit during working hours in all sections where employes are regularly working.

Section 2.—The use of open salamander stoves shall be prohibited.

Rule H—Sanitation

Water Closets

Section 1.—Water closets shall be provided in every foundry for each sex, according to the following table:

Number of Persons.	Number of Closets.	Ratio.
1 to 10	1	1 for 10
11 to 25	2	1 for 12½
26 to 60	3	1 for 16⅔
61 to 80	4	1 for 20
81 to 125	5	1 for 25

For every unit of 45 or fractional part thereof in excess of 125 employes, an additional water closet shall be provided. Where water and sewage facilities are not available, sanitary chemical closets may be used.

RULE I—URINALS

Section 1.—Urinals shall be provided in accordance with the following table:

Number of Persons.	Number of Urinals.	Ratio.
1 to 30	1	1 to 30
31 to 80	2	2 to 40
81 to 160	3	1 to 53⅓

And thereafter an additional urinal to every eighty (80) employed. One individual urinal shall be considered equivalent to two (2) lineal feet of trough or slab urinals.

RULE J—WASHROOMS

Section 1.—Wash basin with faucets for hot and cold water shall be supplied according to the following table:

Number of Persons.	Number of Wash Basins.	Ratio.
1 to 8	1	1 for 8
9 to 16	2	1 for 8
17 to 30	3	1 for 10
31 to 45	4	1 for 11¼
46 to 65	5	1 for 13

For each additional twenty-five (25) employes at least one additional wash basin shall be supplied. Twenty inches of enameled sink, or its equivalent in sanitary properties, shall be considered equal to one wash basin.

RULE K—SHOWER BATHS

Section 1.—Shower baths shall be provided according to the following table:

Number of Persons.	Number of Showers.	Ratio.
1 to 50	1	1 for 50
51 to 100	2	1 for 50
100 to 200	3	1 for 66⅔
200 to 400	4	1 for 100

For each additional two hundred (200) employes, one additional shower shall be supplied.

RULE L—LOCKERS

Section 1.—Individual metal lockers arranged for locking shall be provided for employes, and shall be placed in a space used exclusively for such purposes. This space may be located in the washroom, the drying room, or at convenient places in the molding room.

RULE M—DRYING ROOM

Section 1.—Facilities shall be provided, either in connection with locker room, wash or toilet rooms, for the sanitary drying of workmen's clothes.

RULE N—GENERAL

Section 1.—All the above sanitary provisions shall be conveniently located in a place accessible to and connected with the foundry so that entrance thereto can be had without exposure to the open air. General recommendations to be approved at end of Code.

RULE O—DRINKING FOUNTAINS

Section 1.—Drinking fountains shall be installed at convenient places, and the use of a common drinking cup prohibited.

RULE P—CORE ROOMS

Section 1.—All regulations pertaining to the foundry such as heating, lighting, ventilating and sanitation shall apply equally to the core room.

Section 2.—When core ovens are located in the same room in which the cores are made, the temperature of that part of the room devoted to core making shall not exceed one hundred (100) degrees Fahrenheit.

Section 3.—Separate working space shall be provided where females are engaged in the making of cores.

Section 4.—No female employed in any core making room shall be permitted to handle cores having a temperature in excess of one hundred and ten (110) degrees Fahrenheit.

RULE Q—CLEANING AND FINISHING OPERATIONS

Section 1.—All castings shall, where practicable, be cleaned or chipped in rooms separated from those used for other purposes; but where castings are cleaned or chipped in molding or casting rooms, there shall be provided suitable screens, partitions, or other effective means to protect employes against flying chips or excessive dust.

Section 2.—Where finishing rails or benches are used, these must be sufficiently far apart to allow the operatives to pass between them without being endangered by falling castings.

Section 3.—All cleaning and finishing floors shall be cleaned and leveled at sufficient intervals to insure safe working conditions.

Section 4.—When dry tumbling mills are used exhaust apparatus shall be installed and operated that will effectively draw off the dust created by the operation of such mills, or the mills shall be enclosed in reasonably dust-tight compartments while in operation.

Section 5.—When dry grinding, buffing or polishing floor stand machines are used, exhaust apparatus or its equivalent shall be installed and operated that will effectively remove the dust created by the operation of such machines. This rule shall not apply to floor or bench stands used specially for tool grinding.

Section 6.—Where swing frame or portable buffing, grinding or polishing machines are used, screens shall be provided to protect adjacent workmen.

Section 7.—All abrasive wheels shall be provided with protection hoods adapted to a proper presentation of the work and be mounted with compression blotters, relieved flanges, at least half the diameter of the wheel.

Section 8.—Sand-blasting by hand-operating apparatus shall be carried on in suitable sand-blast rooms. Sand or shot blast operatives shall be provided with suitable helmets or masks, respirators, approved safety goggles, gloves and leggings.

Section 9.—All men engaged in the cleaning and finishing departments shall be provided with approved safety goggles.

Section 10.—All tools shall be kept free from mushroomed heads and kept properly dressed.

Section 11.—All chisel and hammer handles shall be properly fitted and provided with safety wedges.

Section 12.—All electric arc welding shall be properly enclosed to prevent the egress of light rays. Such enclosures shall be properly ventilated.

Section 13.—The operatives shall be provided with improved masks, gloves, and slow combustion aprons.

Section 14.—The use of high explosives is absolutely prohibited on the foundry premises.

Section 15.—The breaking of castings by the use of a drop inside the foundry during the general working hours is prohibited. When a drop is used for the breaking of castings or scrap outside of the foundry, a permanent shield of heavy planking or other protection shall be provided.

Section 16.—Every employe in every foundry shall use the devices furnished for his protection by his employer where there is a hazard connected with his employment.

RULE R—EQUIPMENT

Section 1.—The floor beneath and immediately surrounding a cupola shall be kept free from collection of water.

Section 2.—All pits or openings located in foundry floors shall be guarded by suitable covers or railings or by watchmen.

Section 3.—All ladles pouring from the lip, of two thousand (2,000) pounds or over capacity, shall be equipped with a worm-gear device for tilting same.

Section 4.—All crane, truck and trolley pouring ladles shall be so constructed that the center of gravity shall be below the trunnion, and shall be equipped with a clip to prevent it from overturning.

Section 5.—All single shank hand ladles shall be provided with sheet metal guards.

Section 6.—Where the crown plate of an upright crucible furnace is elevated above the surrounding floor in excess of twelve (12) inches, the furnace shall be equipped with a platform having a standard rail; such platform shall be constructed of metal or other fireproof material, and shall extend along the fronts and sides of the furnace, flush with the crown plate, and shall be at least four (4) feet in width, and shall be clear of all obstructions during pouring time. If the platform is

elevated above the floor in excess of twelve (12) inches the lowering from same of crucible containing molten metal shall be by mechanical means.

Section 7.—When the combined weight of crucible, tongs and molten metal exceeds one hundred (100) pounds, it shall be removed from furnace by two men, or mechanical means, and deposited on the floor.

Section 8.—Equipment used for the movement of materials by overhead cranes, such as sand buckets, shall be of substantial construction. When buckets have movable bails, safety locks or catches shall be provided, and the use of such locks must be enforced.

Section 9.—Substantial cast steel handles shall be provided on grab buckets to afford safe means of pulling or prying apart the jaws in case the cylinders stick.

Section 10.—All equipment such as sand mills, tumblers, etc., shall have gears, belts and all movable parts safely guarded.

Section 11.—All gears, including trolley gears, couplings, keys, set screws and other movable parts shall be completely enclosed by guards, so constructed as to afford easy access for inspection and repairs. Guards shall be strong enough and properly attached to cranes to catch and prevent the falling of the parts which are guarded.

Section 12.—Foot-walks extending the entire length of the crane bridge girders on the line shaft side shall be of substantial construction, rigidly braced to eliminate vibration, having standard railing and toe boards to prevent the falling of workmen and tools, and provide a safe and adequate means of travel about cranes.

Section 13.—Crane cages shall be enclosed to a height of 3 feet 6 inches above the floor with non-combustible material, where molten metal is carried by the crane, otherwise a standard railing and toe board is sufficient.

Section 14.—Fenders shall be provided on all crane end carriage and trolley wheels. These fenders shall be of such shape that they will tend to push a man's hand, arm, or leg away from the wheel.

Section 15.—In all new construction clearances between crane-walks, cages, etc.; and the building walls and roof-trusses shall be ample to insure the safety of crane-men and repairmen.

Section 16.—Suitable electric or mechanical brakes shall be provided to insure the safe movement of cranes and loads.

Section 17.—All cranes shall be provided with a safety lock switch box so that the electric control of the crane can be locked in the off position during inspection and repairs.

Section 18.—All overhead cranes shall be provided with strong foot gongs to warn workmen of the passage of overhead loads.

Section 19.—The practice of riding chain and crane loads shall be prohibited.

Section 20.—The swinging or dangling of loose crane chains as the crane moves down the floor shall be prohibited. In case it is necessary to move the crane along the floor with the chains dangling, the ends must be guided by chainmen walking beneath.

Section 21.—All jib cranes shall be mounted on substantial foundations, and securely anchored to the building. All gears and moving parts shall be guarded.

Section 22.—All sling beams shall be securely suspended from jib crane hooks, and guards shall be installed on the hook to prevent the beams from jumping out of the hooks. Sling beams shall be so constructed that the slings cannot jump off the beam, and can be readily moved to accommodate different size flasks.

Section 23.—Slings of all kinds shall be constructed of material of proper quality and sizes to insure at all times a safety factor of 10.

Rule S—Inspection

Section 1.—All ladles, ladle shanks, crucibles, crucible shanks, crucible tongs, yokes, skimmers, slag hoes, crane chains, cables, ropes and slings shall, prior to their use, be inspected in regard to their safe condition by the men preparing and using such appliances.

Section 2.—An inspection in regard to the safe condition of all hoisting apparatus and accessories shall be made at least once a month by a man designated by the employers for the purpose, and a record shall be kept of such inspection.

Rule T—Employment of Females

Section 1.—No female shall be employed in a foundry unless upon examination by a physician, it has been determined she is of normal health.

Section 2.—No female employed in any foundry shall lift any object exceeding twenty-five (25) pounds in weight, unless she uses mechanical means by which her physical effort is limited to exertion equivalent to that number of pounds.

Rule U—General Regulations

Section 1.—Regulations affecting industrial establishments generally in respect to the safeguarding of transmission machinery, miscellaneous machinery, elevators, stairways, platforms, chains and cranes, or relating to sanitary conveniences and first aid equipment, not included in this Safety Code, shall apply with equal force to foundries.

Section 2.—When handling molten metal, employes shall wear leggings, when possible goggles, and congress type shoes.

The committee makes the following recommendations which it deems most essential in successful accident-prevention work.

Section 1.—All injuries must be promptly reported, no matter how trivial, to proper authorities.

Section 2.—Special efforts shall be made to impress upon all men the necessity of immediately taking care of all minor injuries, cuts, scratches and burns.

Section 3.—It is recommended that tincture of iodine, and not peroxide, shall be used for first aid purposes.

Section 4.—Employes must not, under any circumstances, attempt to remove foreign particles from the eyes of a fellow workman, as infection is almost certain to follow the use of toothpicks, matches, fingers or handkerchiefs for this purpose.

Section 5.—All eye injuries shall be attended to by a regular physician.

Section 6.—The use of liquor shall be absolutely prohibited during working hours.

Section 7.—Accident prevention will be encouraged by the formation of safety committees among the men. All foremen must take a personal interest in accident prevention and are expected to set an example of carefulness.

Section 8.—Strict enforcement of workshop regulations is one of the best methods of accident prevention.

Section 9.—First aid kits should contain:

A—Packages done up in waxed paper containing aseptic dressing and bandages and some safe and effective antiseptic, such for example, as a small vial (1 dram) of 3 per cent solution of tincture of iodine, together with a small camel hair brush.

B—Splints and a roll of bandages.

C—Tourniquet.

It has been proved that 75 per cent of all accidents can be eliminated by educational methods, therefore, the use of bulletin boards, motion pictures, safety meetings and suggestion boxes are to be encouraged.

Section 10.—A room shall be provided and kept in a sanitary condition for the employes' use to eat their meals.

The Alaska Graphite Co., 114 Bush street, San Francisco, which operates graphite mines near Teller, Alaska, recently was reorganized. C. E. Trower, of Napa, Cal., was elected president, H. P. Goodman, vice president and C. H. Jenkins, secretary. A plant will be established in San Francisco for grinding graphite for use in the manufacture of paint, dry batteries, lubricants, etc. Heretofore, the output of this plant has been sold principally to manufacturers of foundry facings.

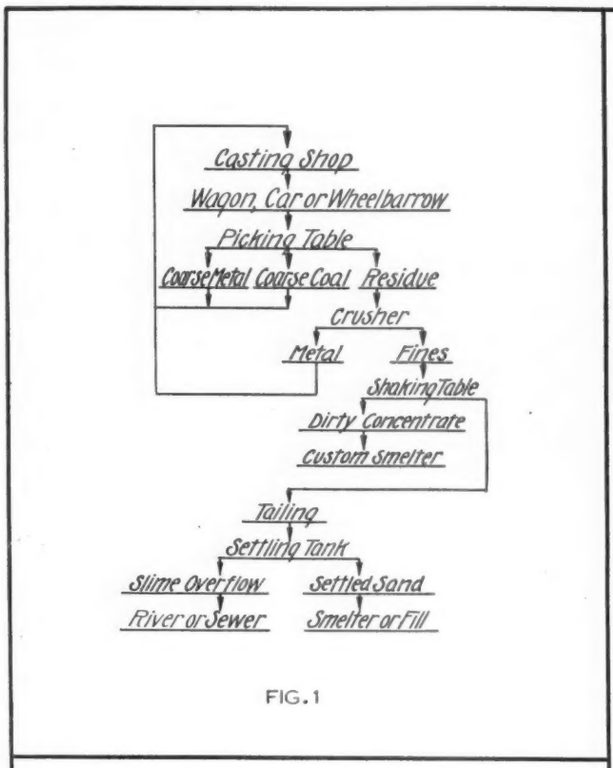


FIG. 1

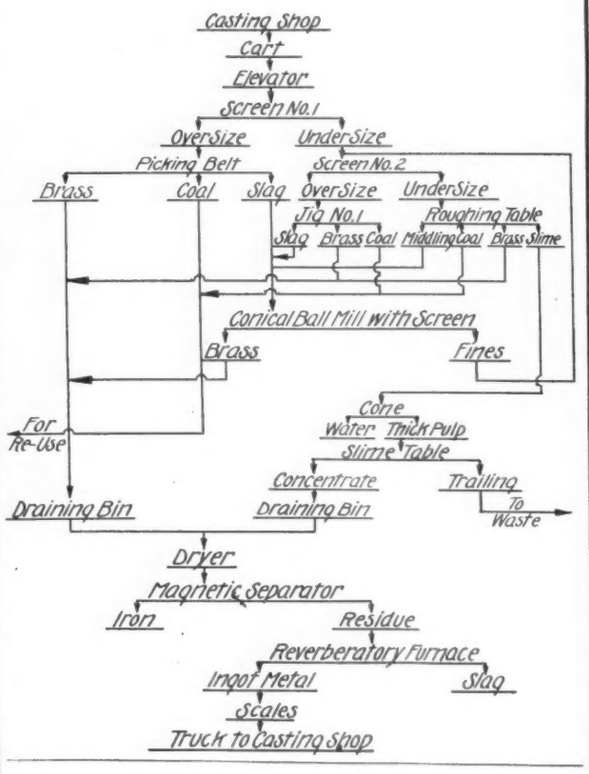


FIG. 2

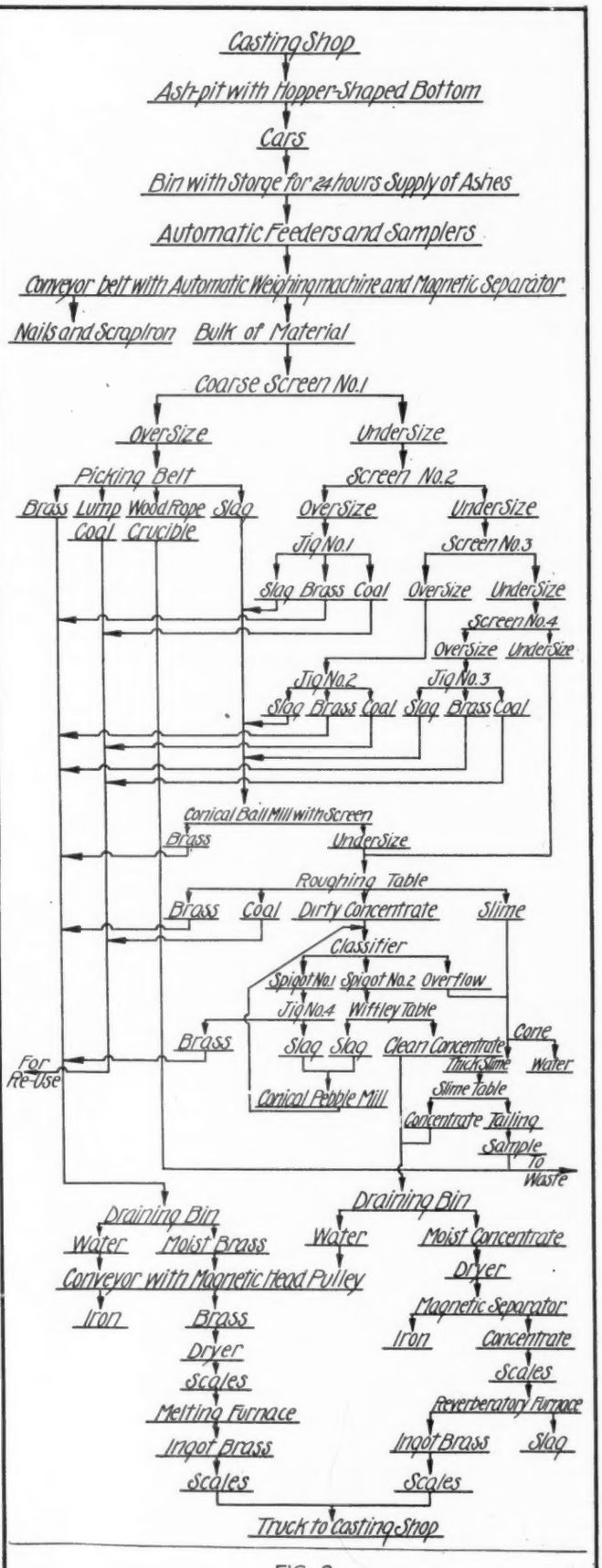


FIG. 3

FIG. 1—FLOW SHEET OF A RECLAMATION PROCESS THAT IS NOT ECONOMICAL. FIG. 2—THE FLOW SHEET OF A SIMPLE AND EFFICIENT PLANT. FIG. 3—TENTATIVE FLOW SHEET OF COMPLETE RECLAMATION PLANT DESIGNED TO HANDLE A MINIMUM OF FIVE TONS OF ASHES PER HOUR

How Brass Ashes Are Economically Reclaimed

Large Quantities of Metal are Wasted Each Year Owing to Unsatisfactory Methods of Reclamation—An Efficient Method of Reclaiming Brass Ashes is Outlined

By Arthur F Taggart

THE recovery of the valuable part of the so-called waste product of manufacturing plants is deservedly becoming of great importance as the prices of raw materials continue their upward climb. In some plants, notably those of the meat packing industry, it is said with justifiable pride that nothing escapes but the worthless odors and useless squeals. In the brass industry such a boast cannot, unfortunately, be substantiated. The fumes that escape are malodorous, but valuable, and the squeal which should mark the loss in the ashes is often absent. It is with the recovery of the valuable metal and unburned fuel from these ashes that the present paper deals. There are methods of recovering the vaporized and oxidized metallic products from the fumes, but they are neither as simple nor as fully understood as the method of ash treatment, and the financial return which they make is not a tithe of that made by a well designed metal reclaiming plant.

A sizing-assay test of a typical casting shop ash is given in Table I. This shows 10.05 per cent copper, which on the basis of a 65-35 brass means 4.5 per cent zinc. A sorting test on this material showed about 15 per cent unburned and partially burned coal. This is for normal operation. Under the stress of maximum production which is the present condition in all brass plants, the metallic content in the casting shop ashes has, to the writer's knowledge, run up to 25 per cent and the coal to 30 per cent of the total ash. In normal times and at ordinary prices for copper, spelter and coal, the gross value of these casting shop ashes per ton is:

Copper, 10 per cent, 200 pounds at 13c	$ 26.00
Zinc, 5.4 per cent, 108 pounds at 6c..	6.48
Coal, 15 per cent, 300 pounds at $2 (50 per cent original B. T. U.)....	.30
Total	$ 32.78

Under present conditions of forced production and high material prices, existing in June, 1916, the value of the ashes is:

Metal, 25 per cent, 500 pounds at 20c.	$100.00
Coal, 30 per cent, 600 pounds at $3...	.90
Total	$100.90

The method of recovering these values varies in different plants, according to the size of the plant and the consequent production of ashes, and according also to the technical talent available. A small number of small plants sell directly to local junk dealers, others ship to custom scrap metal plants; the large majority treat the ashes by some crude method to recover the coarse metal, some of these selling the fine residue at absurdly low prices, the others using it for filling in low ground around the plant. Finally there are a few of the larger companies that treat the ashes in modern, well-designed reclaiming plants, obtaining as products clean coarse metal which can be melted directly into ingots, and fine rich concentrate which is smelted on the ground and which also yields ingot metal.

Table I.

SIZING-ASSAY TEST OF TYPICAL BRASS ASHES.

Screen Aperture mm.	Weight, gm.	Tons per 100 tons.	Assay per cent copper.	Tons copper per 100 tons.
50.8	41,880	10.41	20.2	2.10
26.67	92,740	23.00	5.4	1.24
18.85	51,758	12.85	2.9	0.37
13.33	77,146	19.14	7.5	1.44
6.680	45,264	11.22	9.9	1.11
1.651	31,488	7.81	18.0	1.40
0.833	12,753	3.17	19.9	0.63
0.208	9,761	2.42	23.2	0.56
Through 0.208	40,167	9.98	12.0	1.20
Totals	402,957	100.00	....	10.05

Manufacturers Lose

It is not necessary to enter far into the contracts between the brass manufacturer and the junk dealer or custom smelting plant to find that but a small part of the values in such ashes goes back into the manufacturer's pocket. In none of these contracts is anything allowed for coal or zinc; in many of them zinc is penalized.

Considerable may be said concerning the crude reclaiming plants common in connection with many brass factories. They consist usually of a picking floor or table, from which coarse metal and lump coal are removed, followed by a grinder with restricted discharge such as Chilean and Huntington mills, Krupp ball mills, Hill and Williams crushers, etc. A part of the residue from the picking table is charged into the grinder and the grinder is run until the discharge through the screen has practically ceased, then it is stopped and the cleaned metal which has accumulated within it is more or less laboriously removed. This process is then repeated as often as iss necessary to clear up the accumulation of ashes. The fine product from the grinder is usually run over a shaking table of the Wilfley type, from which a dirty concentrate is recovered. The tailing of the table goes to a settling tank or pond, the overflow of which goes to the river or the sewer. The material settling in the tank is sold for what it will bring. Fig. 1 presents a flow-sheet of such a plant.

The following analysis of this procedure shows its lack of economy. The coarse metal and coal, shown on the flow sheet, are more difficult to melt in crucibles than ingot metal, their composition is uncertain, the oxidation of zinc is excessive, and the slag which adheres to the brass in the coarse metal and is mixed with the metal from the crusher attacks the crucibles. The coarse coal returns full value. Figuring in the treatment charge, the dirty concentrate is paid for on the basis of 60 per cent of the copper content, less a penalty for zinc. In other words, the smelter pays for a part of the copper which it can recover, and it charges the seller with the zinc for which he has already paid a good round price. This product also has to stand a stiff freight charge, and, being fine, it holds a considerable quantity of water on which the shipper pays freight, but for which he gets no return. The overflow has carried many a ton of valuable metal into the sewers and stream beds of the brass manufacturing districts. Notwithstanding the fact that it rarely runs less than 7 or 8 per cent metal and frequently carries 10 to 15 per cent, it is rarely sampled by the metallurgist and its

Presented at the Cleveland meeting of the American Institute of Metals, Sept. 11-15, 1916. The author is assistant professor of mining engineering, Sheffield Scientific School, Yale University, New Haven, Conn.

burden of waste is disregarded in presenting the results of the plant. The most cursory examination of any enlargement of the channel in which it flows will show such a deposition of rich material, due to the temporary slowing down of the carrying current, as should carry conviction to the most prejudiced mind. The character and real value of the settled sand tailing from the shaking table, is best presented by the sizing-sorting-assay test given in Table II. This particular product was sold at $1 per load of about 1.5 tons. On examination it showed 4.23 per cent copper, 2.3 per cent zinc and 23.6 per cent coal coarser than 2.362 millimeters. Of the metal, 85 per cent is easily recoverable in a well designed concentration plant, and of the concentrate thus recovered, 97 per cent of the copper and 15 per cent of the zinc can be saved in a reverberatory furnace, properly constructed and operated. The resulting ingot metal will contain about 92 per cent copper and 8 per cent zinc. The amount of iron present will depend on the method of concentration and the fluxes used in the furnace. The value of the metal recovered will be $8.72 per ton of original settled sand product in normal times, $18.35 at present metal prices. The cost of recovery should not exceed $2 per ton of material, leaving from $6.72 to $16.35 per ton net in this product which was sold for less than $1 per ton. The flow-sheet followed in Fig. 1 also resulted in grinding up and losing more than 450 pounds of coal per ton of ashes. By a proper method of treatment practically all of this coal could have been saved, and the money thus recovered would have gone far toward paying the cost of such treatment.

Table II.

SIZING-SORTING-ASSAY TEST ON TYPICAL SETTLED SAND, FIG. 1.

			Brass			Slag			Coal
On screen Aperture mm.	Weight, gm.	Tons per 100 tons.	Tons per 100 tons.	Assay, per cent copper.	Tons copper per 100 tons.	Tons per 100 tons.	Assay, per cent copper.	Tons copper per 100 tons.	Tons per 100 tons.
18.85	80	1.21	0.063	60.0	0.0378	0.512	2.63	0.0135	0.635
13.33	220	3.33	0.000	....	0.0000	0.380	1.88	0.0071	2.950
9.423	282	4.27	0.000	....	0.0000	0.640	1.47	0.0094	3.630
6.680	420	6.36	0.010	16.70	0.0017	1.580	0.56	0.0088	4.770
4.699	402	6.09	0.040	64.93	0.0259	1.810	1.27	0.0230	4.240
3.327	410	6.21	0.080	65.6	0.0525	2.490	1.37	0.0341	3.640
2.362*	415	6.30	0.110	70.5	0.0775	2.500	2.53	0.0633	3.690
1.651	402	6.09	0.520	54.8	0.2850	5.570	1.67	0.0930	....
1.168	325	4.92	0.800	46.7	0.3735	4.120	0.56	0.0231	....
0.833	332	5.03	0.970	52.8	0.5120	4.060	1.77	0.0718	....
0.589	375	5.68	1.040	55.8	0.5802	4.640	4.31	0.2000	....
0.417	372	5.67	0.270	48.7	0.1315	5.400	3.08	0.1664	....
0.295	418	6.31	0.680	51.7	0.3518	5.630	3.04	0.1711	....
0.208	490	7.42	0.640	35.9	0.2297	6.780	1.50	0.1016	....
0.147	577	8.74	0.480	35.5	0.1704	8.260	0.66	0.0545	....
0.104	513	7.77	0.250	37.0	0.0925	7.520	1.27	0.0955	....
0.074	235	3.56	0.220	28.8	0.0634	3.340	0.76	0.0178	....
through 0.074	330	5.04	0.110	32.7	0.0360	4.930	1.07	0.0528	....
Totals	6598	100.00	6.283	....	3.0214	70.162	....	1.2068	23.555

*Coal not sorted below this screen.

In the following paragraphs is given an analysis of the problem presented in the reclamation of brass ashes with a solution which has been successfully applied. The factors which must be considered in the design of such a plant are:

1.—The character of the ashes.
2.—The quantity of ashes.
3.—The treatment of the products of the concentrating plant.
4.—The characteristics of the machinery to be employed.
5.—Costs, both capital and operating, and their effect on percentages of recovery.

The general system of handling these factors, once they are determined, is by the method of "cut-and-try." The first step is to make a sizing-sorting-assay test of the original ashes. From this is gained necessary information concerning the distribution of metallic values and coal and the amount of slag that must be ground. Grinding, sorting and microscopic tests on the slag afford knowledge as to the distribution and size of the metallic shot which it contains and thus tell to what extent comminution must be carried in order to free for concentration the economic maximum of metal. From the knowledge thus gained an experimental flow-sheet or mill scheme is built up in the laboratory and a test run made to confirm the deductions from the original test. With the further knowledge gained from this test run, and, if necessary, subsequent test runs, a tentative flow-sheet for the mill installation is drawn up. This scheme must be examined critically from the point of view of economical operation, and a balance struck between capital charges and operating costs for the particular quantity of ashes available for daily treatment. It is best to outline the tentative flow-sheet without consideration of the tonnage to be treated, with the aim only of maximum recovery, and estimate the capital and operating costs of this installation. Then by successive elimination of one machine after another and corresponding revision of cost figures and recovery percentages a point will be finally reached which promises maximum financial return. This is not work for a metallurgist inexperienced in construction. The choice of a grinder not specifically suited to the work in hand or the installation of a handling device, elevator or conveyor, of the wrong size or running at the wrong speed, will generally mean the difference between success and failure in a plant that may be otherwise well designed. Originally this information must be gained by careful experimental work on the part of the designer, but fortunately there is sufficient similarity in the various problems arising in the design of reclamation plants to allow the engineer to apply experience gained elsewhere to a large part of the work. When a new problem arises it should be made the subject of careful experimental work before proceeding further.

In Fig. 3 is given a tentative flow-sheet for a plant to treat casting shop ashes ranging in size from 4 inches down to dust and containing 15 to 20 per cent metal and 25 to 30 per cent unburned and partially burned coal. A study of this flow-sheet will show that certain fundamental principles leading to a maximum recovery have been followed. No material containing free metal, that is, metal with no adhering slag, has been sent to a crusher. This means no unnecessary grinding of metal, which would produce fine metallic flakes difficult to recover. No coal is ground. Only the slag which contains included metal shot is sent to the grinders. No material is thrown away until it has been ground

to the finest size. This is done because microscopic examination of the slag has shown included shot in slag particles as small as 0.005-inch diameter. Handling the ashes and products is automatic throughout. The material is weighed and sampled as it enters the plant, the tailing is sampled automatically, and the coal and brass are weighed, so that intelligent direction of the operation is possible. Such a plant as this can be made to discharge tailing containing not more than 0.5 per cent metallic copper, which gives a recovery high up in the nineties. With a leaner feed the tenor of the tailing can be lowered somewhat, but so high a percentage of recovery cannot be expected.

A plant so elaborate as the one just outlined should not be installed to treat less than five tons of ashes per hour. For smaller tonnages the number of screens and jigs should be reduced by increasing the sieve interval, bearing in mind, however, that such a change will be made at the expense of the character of the product. The jig following the rougher may be eliminated as may also the Wilfley table and the conical pebble mill. In the smelting plant one dryer may be eliminated and the reverberatory furnace may be made to serve both for melting the coarse brass and smelting the fine concentrate by providing proper storage capacity for intermittent operation. Weighing devices and preliminary storage may also be sacrificed, but at the expense of smooth running, intelligent operation. Such a simplified plant is outlined in Fig. 2.

Consideration of the details of the machines and their fitness for the particular work required is a subject beyond the range of this paper. An example of the method of determination is given in the paper entitled "Grinding Brass Ashes in the Conical Ball Mill," read at the New York meeting of the American Institute of Mining Engineers and published in the March, 1916, issue of *The Foundry*.

The costs of the plants outlined will depend, of course, on the character of the housing. The smaller plant, with a capacity of 20 tons per day, housed in a wooden building, will cost $15,000 to $20,000; the larger, with a capacity up to 200 tons per day, housed in a steel building, will cost $80,000 to $100,000. A considerable reduction in these figures can be expected if a concentrating plant alone is built. If the plants of the writer's acquaintance are typical, either will pay for itself in increased saving and decreased cost of operation within a couple of years.

Stress Produced by Burning-In Manganese Bronze

By Paul D Merica and C P Karr

THIS investigation of the initial stress produced by the burning-in of manganese-bronze was made in connection with the failure of a number of manganese valve castings used in the Catskill aqueduct. Experience has shown, in brief, that large castings of this material, after some months in service, have developed fissures, through which leakage takes place under only a few pounds of pressure. In most cases, in fact in nearly all, these cracks appear to be close to or in a repair made by the method of burning-in.

These valve castings are quite large, ranging up to 22,000 pounds in weight, and neither preheating of the casting for the welding or burn-in of defective areas, nor subsequent annealing of the whole casting could be conveniently carried out. As a result of the local heating of welding and consequent unequal contraction of different constrained parts of the casting, stresses remained in the casting, particularly severe near and within the burned-in areas; these stresses were in all probability responsible for the subsequent failure at these points. The determination of the values of such stresses, in the case of castings of manganese bronze, in correlation with the physical properties and structure of this material as welded or burned-in seemed desirable.

For the investigation of these stresses, a form of casting, shown in Fig. 1, was chosen. It is a double-bar frame, the two cross-bars, *A* and *B*, having sections of area, 1 x 1 inch and 3 x 3 inches respectively. They are connected by heavy and stiff ends *M* and *N*. The inside length from *a* to *b* of the bars was about 9 inches.

Method of Investigation

A portion of the bar *A*, varying from ¼ to 2 inches in length, was removed by sawing, and replaced by burning-in with the same material, care being taken to keep the bar, *B*, cool during the operation. The pouring gate for the burning-in was then sawed off, gage points placed just inside of *a* and *b*, and readings taken with a strain gauge before and after sawing through *A* outside of the gage point, at either *a* or *b*. Knowing the elastic modulus of the material and the contraction over the 8-inch gage length, a direct calculation gives the value of the stress in the bar *A*.

Some interest attaches to the method by which the welding was accomplished. In all cases the casting was placed on its side and imbedded in green sand, a pit was then hollowed out by hand around the severed ends of *A*, such as to expose these ends, and the bar, from ¾ to 1 inch back, and to allow a small channel-way, from ⅛ to ⅛ inch wide around the bar at these ends. The sand was built up slightly and a hollow iron cylinder, about 4 inches high, set over the pit, thus providing a sufficient pouring head. It was found necessary to preheat the ends to be welded, not only by means of a torch, but also by making a small reservoir in the sand directly under the burning-in pit, separated from it by sheet-iron plates, and pouring hot metal into this reservoir immediately before burning-in. No flux of any kind was used.

The molten metal was first poured into this reservoir, and then into the pit, completely enveloping the ends and filling the pouring head. In order to be certain that the bar, *B*, of the casting was actually kept cool during the operation, this part was in several instances water-cooled while the weld was made.

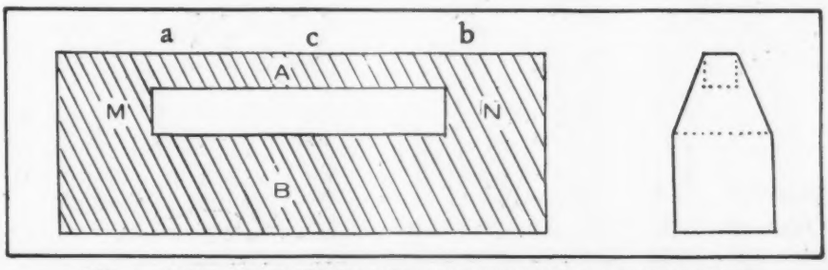


FIG. 1—FORM OF CASTING USED IN BURNING-IN EXPERIMENTS

A paper presented at the annual meeting of the American Institute of Metals, Cleveland, Sept. 11 to 15, 1916.

This was done by boring a 1-inch hole longitudinally through the center of *B*, attaching pipe and hose and running water through during the operation of burning-in. The metal came from a large scrapped manganese bronze casting, kindly furnished by the New York board of water supply. It had the following composition:

	Per cent.
Copper	58.5
Zinc	39.1
Tin	1.0
Lead	trace
Iron	1.4
Manganese	none

Table I gives the value of the tensional stresses found in the bar *A* of the various castings tested.

It is not difficult to make an approximate calculation of the stress in the bar *A*, which should result from the burning-in. Assuming that the coefficient of linear expansion is constant, that the temperature distribution along the bar *A* at the moment of solidification of the metal is equivalent to a temperature equal to that of the melting point of the metal over ½ times the length burned-in, that the stresses are at all times less than the true elastic limit of the material, and making approximate calculation for the stiffness of the ends *M* and *N* of the frame, the tensional stress resulting in *A* for every inch of metal burned-in should be 36,000 pounds per square inch.

There results, actually, a stress of from 8,000 to 10,000 pounds per square inch, irrespective of whether ¼ inch or 2 inches of the bar *A* were burned-in. This indicates, of course, that at some temperature, the resulting stress becomes greater than the elastic limit of the material, and the material yields thenceforth, the stress following (with probably some time lag) the elastic limit of the material, such that the stress, as measured, one or two days after burning-in, represents the true elastic limit of the material.

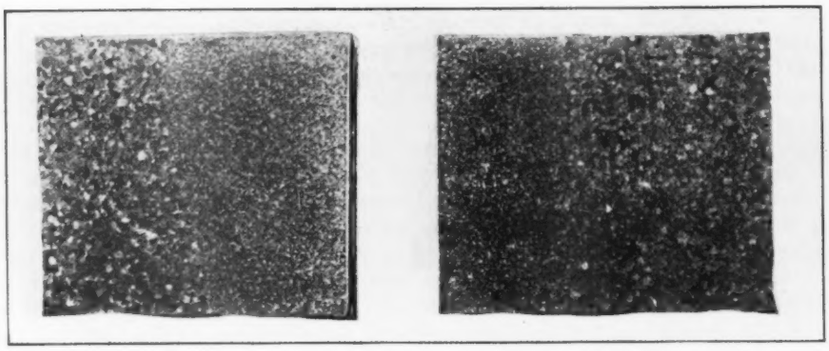


FIG. 2—GRAIN STRUCTURE OF SECTION THROUGH BURNED-IN ZONE

Table I.

STRESSES PRODUCED BY BURNING-IN MANGANESE BRONZE.

No. of casting.	L'gth of Bar A, burned-in inches.	Stress after burning-in lbs. per sq. in.
232a	0.25	9,600
232b	0.50	weld not sound
232c	0.50	9,200
232d	0.50	8,500
232e	0.50	8,500
232f	2.00	6,400
232g	2.00	8,500

A tensile test was carried out on a specimen from the bar *A* of casting No. 232g, and gave the following results:

Ultimate strength, lbs. per sq. in..	60,000
Proportional limit, lbs. per sq. in..	13,000
Modulus of elasticity, lbs. per sq. in.	15.4×10^6
Elongation in 5 in., per cent.....	19.4
Reduction of area, per cent.....	26.0

The fracture occurred outside of the welded area, but not at the juncture of the original and the welded-in portions, and the welded-in section of the test piece was harder and less elongated than the original material. The fracture showed only a few minute flaws; it may be accepted, therefore, that the true elastic limit of the material was somewhat below the proportional limit in this case. Consideration of the microstructure of the burned-in metal affords an explanation for its greater hardness. Fig. 2 shows the grain structure within and without the welded-in area of the specimen No. 232c. It is seen that the central welded portion is of much finer grain than the original material, as cast, on either side, and the transition from welded to original structure is very abrupt. In Figs. 3 and 4 are shown the microstructures, inside and outside respectively, of the burned-in zone. The structures are those of normal manganese bronze, there being no difference in the two, other than that of size of grain. No evidence of overheating or of burning-out of the zinc near the juncture of the zones was noted. These results may be compared instructively, with those obtained by Carnevali, on similar alloys, in which the welding was done by means of the oxy-acetylene flame. In this case a burning-out of the zinc took place at the juncture of the weld. It is not surprising to find such differences in the results by the two methods, as greater opportunity for oxidation and overheating is given by the use of the oxy-acetylene process.

The bar *A* of casting No. 232h, with 2 inch burned-in, was brushed over continually with a solution of mercurous nitrate for about two weeks, but showed at the end of that time, no fissures or sign of failure.

A small portion, about 6 inches, of the bar *A* of casting No. 232e was wound with resistance wire and the bar thus

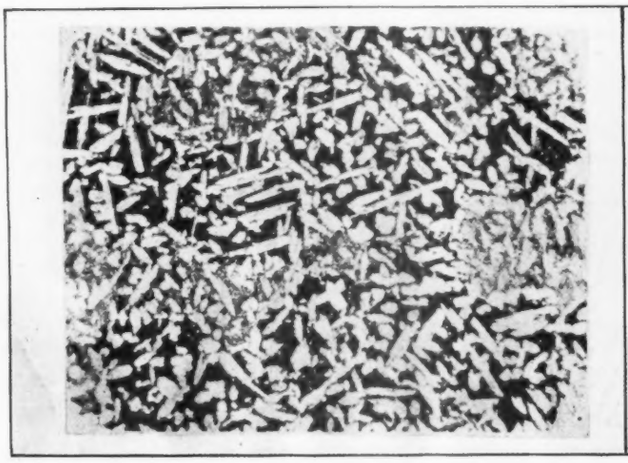


FIG. 3—WITHIN BURNED-IN ZONE

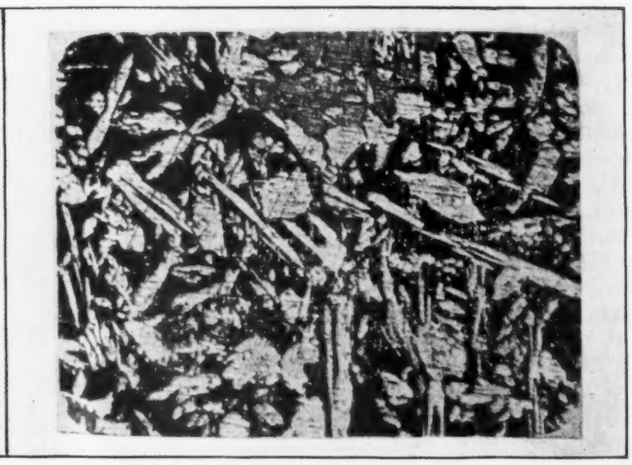


FIG. 4—MICROSTRUCTURE OF BURNED-IN BRONZE CASTING

locally annealed at a temperature of 300 degrees Cent. for about one hour. The stress in the part *A* remained unchanged by this treatment. It may be noted that if it is wished to relieve the stresses in *A* by some heat treatment affecting it only, the part *B* being kept at the ordinary temperature, the part *A* should be cooled 50 or 100 degrees instead of being heated.

The experiments described have indicated how readily severe stresses may be introduced into a casting by the burned-in or welding of a constrained area or portion of it. The form of casting used in these experiments was such that no bending or distortion, tending to relieve the stresses, was possible during cooling, and this must be borne in mind in applying these results to the consideration of the effect of burning-in on more complicated shapes, where such distortion does occur.

In the spherical shell or dome-shaped valve castings of the New York board of water supply, for instance, burning-in would tend to flatten the shell, and in so doing, partially relieve these stresses, and it is most difficult to calculate the stresses in such a case. The authors are inclined to believe that even in these cases local stresses of values equal to the true elastic limit must have been produced, and which would account for subsequent failure. One conclusion to be drawn, therefore, is that the welding-in of constrained portions of castings of manganese bronze, produces in general local initial tensional stresses within and near the burned-in zone, with values equal to the true elastic limit of the material, unless the shape of the casting is such that extensive distortion may occur. It also may be concluded that such castings should be either preheated carefully for welding, so that all parts of the casting cool down together from a dull red heat, or, the casting should be subsequently annealed. Experience indicates that a low temperature anneal is sufficient for this purpose—from 400 to 500 degrees Cent. for from one to two hours. Either of these precautions should eliminate the local stresses resulting from the burning-in and should produce castings free from danger of subsequent cracking.

Operating a 25-Ton Air Furnace at Low Cost

By F C Rutz

THE malleable furnace has perhaps escaped being written about as much as any one subject pertaining to the malleable industry, and yet it is one of the most important. Improperly constructed or improperly handled furnaces are apt to wreck the best chemically calculated heat. Simple measurements of the openings between the top of either front or back bridge and the bottom of the bungs over them, are apt to make either for melting with just the proper oxidizing flame, or slow melting. The latter gives the flame too much play on a slow trickling of metal causing the familiar "high heat", or too low a silicon content.

A properly handled furnace will cause the metal to collapse quickly into a molten state, giving the desirable snappy life and fluidity, with a consequent decrease in defective castings. In my opinion, after having had experience with various sizes of furnaces, the 25-ton furnace has a sufficient number of points in its favor to warrant its adoption. These points include (1) decreased operating expense, (2) flexibility, and (3) space economy.

Let us first consider decreased operating expense. From cost figures available, the larger furnace can be operated at a total cost of $3.25 per ton, including firemen, coal, ash, slag and repair labor, all materials, tools and equipment. This figure is an average cost for the past four years, based on average heats of slightly over 18 tons. The charges are proportioned as follows:

	Per Ton
Firemen, labor	$0.25
All other labor	.40
Coal	2.00
Brick	.38
Fire sand and clay	.05
Tools and equipment	.16
Motor and fan repairs	.01
Total	$3.25

From figures available, obtained from a number of sources, covering costs on 12 to 15-ton furnaces, the cost of melting per ton averages approximately $3.85. Owing, however, to different methods of distributing costs, a satisfactory comparison cannot be arrived at, itemized as above. The final result, however, seems to be greatly in favor of the larger furnace.

Regarding the melting ratio, a fair average covering a year's tonnage, actually poured, would be 2.75 : 1, after allowing approximately 13 per cent for shrinkage on the total amount charged owing to oxidation, slag, etc.

Taking up the question of flexibility, the advantage also appears to be greatly in favor of the larger furnace, owing to its adaptability for either large or small loads, depending upon the grade of work that one desires to make. Small heats of 12 to 15 tons can be handled as successfully as 20 to 25 tons, merely by keeping the bath of the metal at the proper depth. Another valuable feature of the larger furnace is the great space economy that can be effected, owing to its ability to do practically double the work of the 12 to 15-ton furnaces. The saving of floor space may be turned into productive channels.

In conclusion let me present just a word regarding the detailed dimension figures of a successful 25-ton furnace. The grate surface is 5 x 8 feet. The grate bars are 6 inches wide, with ⅝-inch openings. The opening from the top of the front bridge to the bottom of the center of bung is 27 inches. The back bridge opening is 12½ to 13 inches. The lower blast pipe is 17 inches in diameter. The top blast is 6 inches in diameter. From it eight pipes having 2⅛-inch openings, pitched so as to strike at the base of the front bridge wall, extend through the wind bung. The height of the front bridge from the top of the grates is 40 to 42 inches. The blast pressure is five ounces. The above dimensions have proved the most successful among a number of experiments made to get the most economical results.

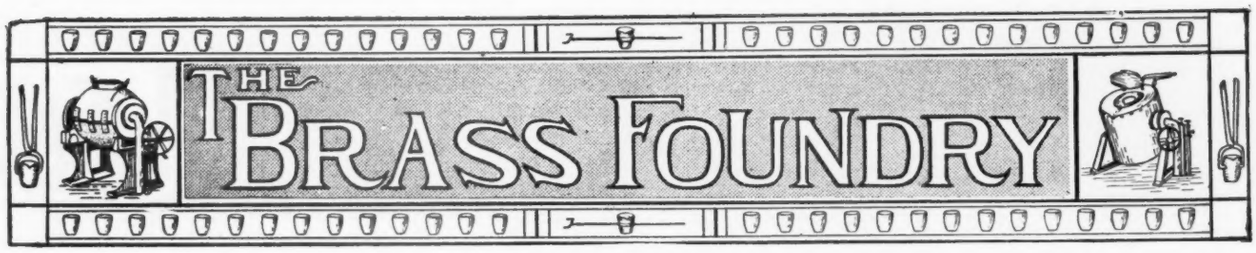
A paper presented at the annual meeting of the American Foundrymen's Association, Cleveland, Sept. 11 to 15, 1916.

Casting Rims and Hubs on Sheaves

By Walter L. Russell

In the August number of *The Foundry*, page 332, was published a question and reply relative to the casting of rims and hubs on sheaves, the foundry making the inquiry being troubled with the breaking of the spokes.

We have experienced similar difficulties in our shop and these may be overcome if the hub is cast first, followed by casting the rim the next day or by casting the rim after the metal in the hub has set completely. In my opinion this trouble is caused by contraction, since casting the hub after the rim causes the spokes to break.



Chemistry in the Brass Foundry---V

By E P Later

IN POINT of usefulness, as far as alloys are concerned, tin ranks with copper and zinc. It forms important combinations with several of the other metals and may be found, in widely varying amounts in a large number of alloys. Thus, while ordinary brass is essentially a copper-zinc alloy, it may contain a few tenths to several per cent of tin, which has been added to harden it. Simple bronzes, strictly copper-tin alloys, contain from a few tenths to 30 or 35 per cent of tin, depending on the uses to which they are to be put, while phosphor bronze, silicon bronze, manganese bronze, etc., contain varying, although usually fairly small, amounts of tin. In addition to these, most bearing metals, fusible alloys, solders,—the latter being essentially lead-tin alloys,—type metal and a large variety of similar metals contain from 2 to 90 per cent, or more, of tin.

One of the simplest methods for determining tin, but which unfortunately can not always be used or recommended, depends on the fact that nitric acid converts tin into a white precipitate of hydrated oxide, or metastannic acid, which may be filtered off, ignited and weighed and the amount of tin calculated.

In practice this is carried out by weighing off from 1 to 5 grams of alloy, depending on the probable amount of tin present, placing it in a suitable beaker and pouring over it about 15 c.c. of dilute nitric acid in the proportion of two parts acid to one part water. The beaker should be covered with a watch glass and when the action becomes less violent the liquid should be boiled until no more red fumes are given off, after which it should be diluted to 75 c.c. and filtered through a double filter. The precipitate and paper are then dried and separated, the latter burned in a weighed crucible or dish, cooled, the ash moistened with nitric acid and again heated, cautiously at first, until the acid is driven off. The precipitate then may be added to the residue in the crucible and the whole heated gently at first, then with the full flame of a bunsen burner. After cooling in a desiccator the crucible may be weighed, the increase in weight representing tin dioxide, which will contain a small amount of impurities in the form of the oxides of other metals. Multiplying by 0.7879 expresses the result as metallic tin, from which the per cent present in the sample may be calculated.

It may easily be seen that the results are liable to be somewhat high, as the impurities which are present in the precipitate are reckoned as tin. Ordinarily, brass contains only small amounts of tin, however, and when a high degree of accuracy is not required, as will often be the case, this method will give sufficiently close results.

Elimination of All Error

If error is to be eliminated to a large extent, this precipitate may be purified after weighing and the amount of foreign matter found subtracted from the weight of the impure oxide, although this procedure is not altogether satisfactory.

A mixture of equal parts anhydrous sodium carbonate, that is, containing no water of crystallization, and sulphur is prepared and thoroughly mixed, and after the tin oxide has been weighed it is well stirred with about ten times its weight of the foregoing fusion mixture, the lid of the crucible is placed in position and the whole is heated over a small flame until the flame of burning sulphur between the crucible and lid just goes out. The crucible is allowed to cool, then is placed in a beaker of distilled water and gently boiled until the mass is broken up and the soluble matter in solution, after which it may be removed and washed off with a jet from the wash bottle, allowing the washings to run back into the beaker. A solution of sodium thiosulphate is then added until the brown color of the solution fades to a pale yellow.

The liquid then may be allowed to stand until the suspended sulphides of copper, and possibly lead and iron settle out; these next may be filtered off and washed, first with water containing sodium sulphite, then with hydrogen sulphide water. Finally, the precipitate and filter are burned in a weighed crucible, cooled and weighed again. This time the difference between the two weights represents the impurities which were present in the tin oxide and subtracting this from the original weight of the impure oxide will give the weight of pure tin oxide. This then may be multiplied by the factor given, 0.7879, to obtain the correct weight of the tin present.

One of the quickest and most satisfactory methods of estimating tin is volumetric in principle and depends on the oxidizing action of an iodine solution under proper conditions. The iodine solution is prepared by dissolving about 11 grams of iodine in 200 c.c., or so, of distilled water containing 20 grams of potassium iodine, shaking the mixture well until solution is complete and then diluting to one liter. This must be standardized, of course, before being used and perhaps the most convenient way of doing this is to weigh accurately 0.2 gram of powdered, pure arsenious oxide and place it in a 6-ounce flask. A few cubic centimeters of a dilute solution of sodium hydroxide then are poured over it and warmed gently until the oxide is all dissolved, after which the solution should be diluted to 100 c.c. with distilled water, and a few drops of phenolphthalein solution added. This is made by dissolving one gram of the solid in 100 c.c. of alcohol. The neutral alcholic solution is colorless, but alkalis turn it a deep red which color is immediately discharged, or made to disappear upon neutralization of the alkali with an acid.

Hydrochloric acid next is added slowly to the arsenic solution until the pink or red color just disappears, then three or four drops excess are added and the whole is cooled down to room temperature, or lower. Several cubic centimeters of a cold, saturated solution of sodium acid carbonate then should be added, together with several drops of starch solution, directions for

its preparation having been given in a previous article of this series, and it will then be ready for titration.

The burette should be cleaned and filled with the iodine solution which should be run into the arsenic solution until the final drop or so produces a strong blue color. The burette reading then may be noted and the value of the iodine solution calculated. It must be remembered that this has been standardized against an arsenic solution while we desire to ascertain its value in terms of tin; 0.2 gram of arsenic are equivalent, in this particular instance, to 0.2404 gram of tin and therefore, the value of the iodine solution may be found by dividing the equivalent weight of tin taken, 2404 gram in this case, by the number of cubic centimeters of iodine solution required.

In applying this method, which was proposed by Pearce and modified by Low, to the estimation of the tin in an alloy, one gram of the latter should be weighed out and placed in a large sheet iron crucible — approximately 60 c.c. capacity—fitted with a porcelain cover. Eight grams of stick sodium hydroxide are added, the crucible is covered and heated, slowly at first, and then with the full flame of a bunsen burner until the mass is entirely molten and quiet. A nickel dish, 2½ inches in diameter, should be floated on a beaker of water and the melt poured into it, covering the cake with a small crucible cover to prevent pieces of the former flying about and causing a loss, if it should crack on cooling.

Determining Tin in Alloys

The crucible may be placed on its side in a large casserole or dish containing a small amount of water and boiled. When the outside is clean the crucible may be removed and the outside washed off, allowing the washings to run back into the solution. If any of the melt adheres to the inside of the crucible a little dilute hydrochloric acid may be poured into the crucible and stirred with a stirring rod until everything is in solution; then the liquid may be poured into the casserole and the crucible rinsed. The cake in the nickel dish now may be put in the casserole, 30 c.c. of strong hydrochloric acid added and the whole heated to boiling until the cake dissolves, after which the cover of the casserole may be removed and rinsed off and the solution transferred to a 6-ounce flask. Several iron nails should be put into the solution and the latter heated to boiling and set aside for about one-half hour. This treatment will reduce all iron and tin salts to the lower state of oxidation and precipitate out metallic copper, antimony and perhaps other metals; therefore the solution will need to be filtered. It is recommended that this be done by placing a plug of moistened absorbent cotton in a funnel and pouring the solution over it, keeping the nails in the flask, finally washing thoroughly with cold water. The filtrate may be allowed to run into a 12-ounce flask, in which has been placed a little powdered sodium carbonate and a few cubic centimeters of hydrochloric acid; this will set free carbon dioxide, thus displacing the air and preventing the oxidation of the reduced tin salts. A few cubic centimeters of starch solution now may be added to the solution and the latter titrated with iodine solution until the deep blue color makes its appearance, as previously directed. From the amount of iodine solution required, as shown by the burette reading, the per cent of tin in the sample may be calculated.

Estimating Tin Electrolytically

Tin also may be estimated electrolytically, but as the methods for doing this involve considerable manipulation and do not offer any particular advantage over those already given they will not be discussed.

Considering briefly the uses, as far as they affect the brass foundryman, and methods of estimating lead, this metal finds very little employment in brass, although certain bronzes contain fairly considerable amounts of it. Small quantities of it improve the machining qualities of brass markedly, but large amounts make it brittle. Ordinary material contains from a few tenths of one per cent to about 3 per cent, more or less, depending on the quality and the uses for which it is intended.

Like tin, lead, however, is one of the main constituents of a very large number of alloys, solders, bearing metals, low-melting point metals, etc., and by reason of its low price and desirable qualities, it finds a wide field of usefulness in one way or another.

A gravimetric method is widely used for the estimation of lead, depending on the insolubility of the sulphate in water, especially in the presence of small amounts of sulphuric acid and alcohol. To the solution containing the lead a few cubic centimeters of strong sulphuric acid are added, then heated over a flame, as previously described, until dense, white fumes are emitted. This solution is cooled, diluted to 75-100 c.c. with distilled water and again heated to boiling, to dissolve all soluble sulphates, and finally filtered off through a weighed Gooch crucible or a paper filter, washing the precipitate first with water containing about one per cent of sulphuric acid and finally with alcohol, to remove all traces of acid.

If the Gooch crucible is used it should be heated to a low red heat for 10 or 15 minutes—directions for doing this have been given previously—then allowed to cool in a desiccator and weighed.

When a paper filter is used the precipitate and filter are dried at a temperature of about 215 degrees Fahr. for an hour, after which the precipitate is carefully detached and brushed into a weighed porcelain crucible and the paper burned in a spiral of platinum wire or held in a pair of tongs above a watch glass or crucible cover and burned, allowing the ashes to fall on the watch glass and finally brushing them into the crucible with the rest of the precipitate. The latter should be moistened with a drop or so of nitric acid, as the burning paper always reduces some of the lead sulphate to the metal and unless this were again changed to the sulphate, an error would be introduced. The excess of nitric acid is carefully evaporated off, then the precipitate is moistened again with a drop of sulphuric acid and the crucible heated gently until no more fumes are given off, after which it should be allowed to cool in a desiccator and weighed.

The final product is the same, lead sulphate, whether the Gooch crucible or paper filter is used, and the weight of lead in this compound may be obtained by multiplying it by 0.6831.

Volumetric Determination of Lead

When it is desired to use a volumetric method, what is known as the molybdate process may be employed. In this the lead is precipitated as the sulphate with sulphuric acid, evaporating over a flame until heavy, white fumes come off, as before. The solution then is cooled, diluted with distilled water and filtered, washing the precipitate with water containing one or two per cent of sulphuric acid and finally it is washed once or twice with cold water alone. The precipitate then should be transferred—this is best accomplished by means of a jet from the wash bottle—to a beaker and boiled with about 35 c.c. of ammonium acetate solution until the lead sulphate is all in solution. The ammonium acetate solution is prepared by dissolving 20 grams of the salt in 100 c.c. of water. If any residue remains after boiling the lead sulphate with the acetate solution it should be filtered off and washed with hot water. The filtrate or solution is made slightly acid with acetic acid, after which it is ready to be titrated with the molybdate solution.

This solution is made up by weighing out about 8.6 gram of ammonium molybdate, dissolving it in distilled water and diluting to exactly one liter. Of course, it is necessary to standardize this and for this purpose two or

three samples of pure lead foil of about 0.3 gram each are weighed and dissolved separately in 15 c.c. of nitric acid diluted with its own volume of water. When they are entirely dissolved, enough dilute sulphuric acid is added to throw all of the lead down as the sulphate. This precipitate is allowed to settle and then filtered off, keeping as much as possible of it in the beaker or flask, and washed several times with water containing one or two per cent of sulphuric acid, finally ending with one or two washings with cold water, to remove all acid.

Any precipitate on the filter is dissolved by pouring a hot solution of ammonium acetate over it several times and finally washing with hot water, allowing the acetate solution and washings to run into the beaker or flask containing the rest of the lead sulphate. The solution then is heated if necessary until all of the lead sulphate goes into solution, after which it is made slightly acid with acetic acid, diluted to 200 c.c and titrated with the ammonium molybdate solution, using a solution of tannic acid in water, 0.3 gram in 100 c.c., as an outside indicator. The solution should be stirred constantly and the molybdate run in, testing frequently, until a drop of the former gives a yellow color when placed on a drop of the tannic acid.

The value of the molybdate solution in terms of lead may be determined as usual by dividing the weight of lead taken for the test by the number of cubic centimeters of solution required.

Estimating Lead Electrolytically

Lead also may be estimated electrolytically, a procedure which finds rather wide employment, but it differs from the metals which have so far been considered in that it appears on the anode as lead peroxide, instead of coming out on the cathode or negative pole as the metal. It should be stated that trouble is sometimes experienced, particularly when large amounts of lead are present, in getting the peroxide to adhere to the electrode, as it tends to flake off, making the results low. The exercise of caution to see that all of the conditions are properly adjusted, that is, deposition from a strongly acid solution onto a gauze electrode by means of a current of fairly high density, will practically eliminate any trouble of this sort.

A convenient way of conducting the operation is to obtain the lead as a precipitate of lead sulphate. The details of doing this will be discussed later. The lead sulphate is filtered off and washed with water containing a little sulphuric acid, as directed before, finally with one washing with cold water. The precipitate then should be washed by a jet from the wash bottle into a large beaker, 250 c.c. capacity, several cubic centimeters of ammonia added and the whole heated gently until the lead sulphate is converted into the hydroxide. This solution should be poured slowly into a 200 c.c. electrolyzing beaker containing about 20 c.c. of strong nitric acid, stirring constantly with a glass rod. If necessary, the solution may be heated for a few minutes or until everything goes into solution. It then may be diluted to about 150 c.c. with distilled water, the previously cleaned and weighed electrodes introduced and the apparatus connected up, making the gauze the anode or positive pole, instead of the negative as usual. The current should be about 1.4 amperes for each 100 square centimeters of active electrode surface.

All the lead should be deposited in an hour or so, depending on conditions, then the electrolyzing beaker should be lowered away from the electrodes without breaking the current and these washed with distilled water, dipped in

(*Concluded on page* 443.)

PROBLEMS OF THE BRASS FOUNDER

What To Do and How To Do It

Counteracting Aluminum Shrinkage

We are making cast aluminum dies for hats, but we experience difficulty in preventing checking or cracking at the juncture of the thin and thick sections. The castings vary in thickness considerably, some parts being 3 inches and others only ½ inch. The molds always are well vented, rammed as soft as possible and skin-dried and are sprayed with crude oil. We are using zinc chloride for fluxing. Can you give us an idea of how we may prevent this difficulty in the future?

The cracks can be prevented by the use of chills, which may be made of bronze from patterns made by applying plaster of paris to the part of the pattern where the chill is to be used. When the plaster has set, whittle it to shape and cast it in copper or bronze. When making the mold for aluminum, set the chill in position against the pattern and run it in place. The aluminum should be poured fairly cool and as large a riser as the pattern will permit should be attached to the heavy sections. The object of the chills is to set the heavy sections so that the casting is cooled more uniformly than otherwise and to prevent straining, which would fracture the casting.

How to Utilize Brass Turnings

Until recently we melted new metals almost entirely, but since the rapid advance in price we are using considerable scrap. In remelting turnings we add 5 pounds of lead to each 100 pounds of turnings, to which is added 4 ounces of phosphor-copper. We would like to know if we would obtain better results by using a small percentage of pure manganese in the mixture in place of phosphor-copper.

Unless the analysis of the turnings is known so that the content of lead can be regulated, it is unwise to add lead, because it always can be taken for granted that those who made the castings from which the turnings were cut missed no opportunity to add lead thereto. Perhaps the metal contains too much lead and better results will be obtained if the addition of lead was omitted. The use of manganese would not help in this case and we do not recommend it. However, if it is desired to try the addition of manganese, obtain an alloy of manganese and copper containing 30 per cent manganese. The 15 per cent phosphor-copper alloy most generally is used.

Steam Metal Mixture

We would like to obtain a formula for a good steam metal suitable for valves to withstand a steam pressure of 150 pounds.

The following alloy will be found satisfactory: Copper 88 per cent; tin, 4 per cent; zinc, 4 per cent, and lead, 4 per cent.

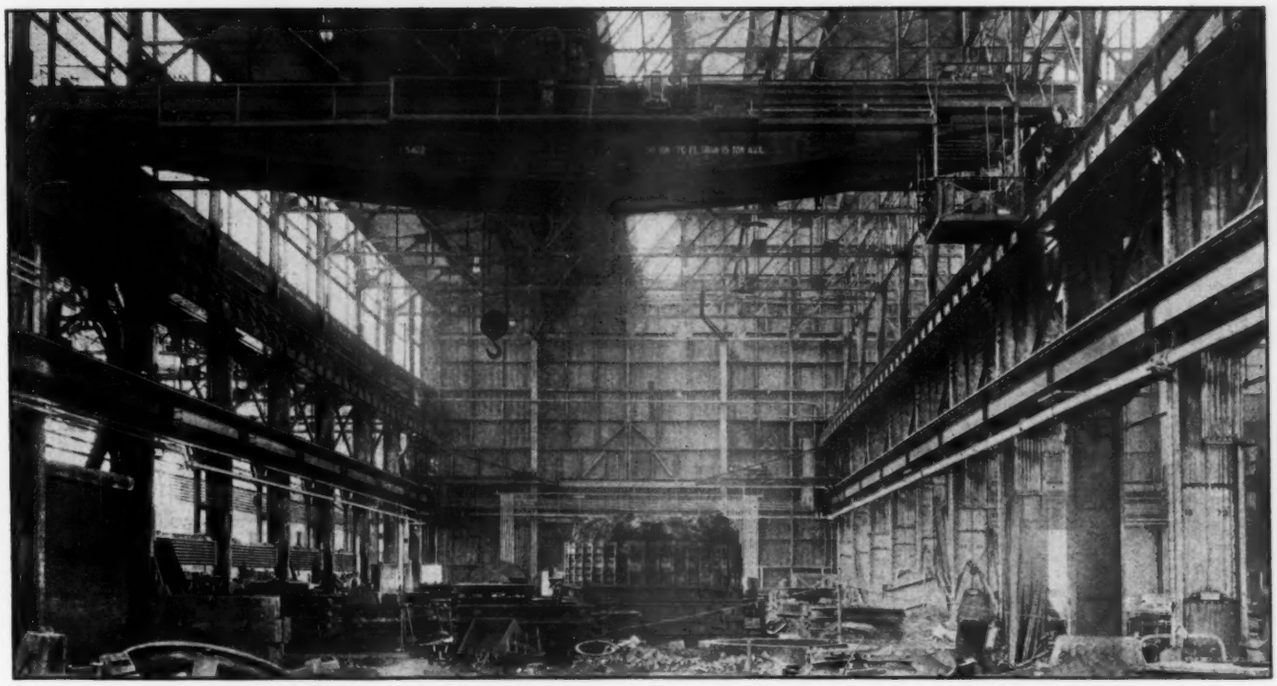


Fig. 1—A View of one Section of the General Electric Co.'s Foundry, Erie, Pa., Showing a 50-Ton Crane Serving the Molding Bay

Electricity in the Foundry

By R H McLain

EXCEPT for the presence of a greater amount of dust and dirt, the use of electricity in the foundry imposes no new conditions on the installation of lights and motors other than those which already have been successfully met in almost every line of industry. Grinders, mixers, blowers, lifting magnets, and many other such forms of equipment are the same everywhere. The foundry crane, however, is distinctly different, and so the construction, specification, and care of the crane used in the foundry must be treated at some length. In general, it may be said that all motors used in the foundry should be equipped with enclosed or dust-proof bearings. In addition, all direct current motors should be completely enclosed to protect commutators and brushes. Control boxes, also, should be made substantially with enclosed parts to protect the working parts from dust and grit and the workmen from coming in contact with live parts. A liberal use of common sense in the care of motors and controls will be fully as well repaid in the foundry as in any other line of manufacture. Occasional inspection of bearings exposed to dust, the frequent application of oil, and the covering of motors left idle for long periods of time are details of care, the observance of which will result in greatly extended motor life.

The most important and expensive item of foundry equipment is the electric crane. Therefore, it should be selected only after a careful scientific study of the conditions to be met. Where more than one crane is to be installed, the problem often may be simplified by arranging for one or two large cranes and several smaller side-wall traveling cranes which serve as feeders to the larger ones and may pass beneath them.

Perhaps the most important detail of crane construction to be settled upon is hook speed. The temptation always is to make the hook speed as great as possible, but there are certain definite limits beyond which it is not advisable to go. Forty feet per minute is the speed generally used on 5-ton cranes. Fifteen feet per minute is common on larger cranes, and on cranes geared for higher speeds difficulty is often experienced in drawing patterns at a speed of 4 or 5 feet per minute. In meeting such requirements, direct current has a distinct advantage over alternating unless the difference is made up in the lower hook speed of the alternating current crane. In either case, a well built crane, a good system of me-

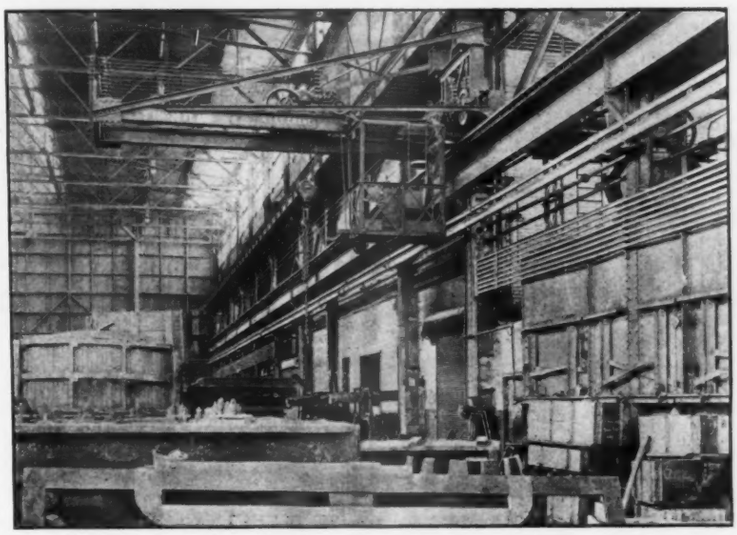


FIG. 2—A FIVE-TON TRAVELING JIB CRANE SERVING A MOLDING BAY IN THE ERIE WORKS OF THE GENERAL ELECTRIC CO.

Abstract from a paper read by R. H. McLain, of the General Electric Co., before the American Institute of Electrical Engineers.

FIG. 3—ELECTRIC LOCOMOTIVE USED IN THE YARDS OF THE SCHENECTADY, N. Y., WORKS OF THE GENERAL ELECTRIC CO.

chanical brakes, etc., make a decided diffference in the accuracy of control. However, with all other conditions equal, alternating current is still at a disadvantage.

On a crane running at 60 feet per minute or less, a controller viewed from the standpoint of the operator, really needs only two points for hoisting and two points for lowering. Of course, in ordinary commercial controllers, more than two points of control are necessary in order to transfer the motor speed without undue shock from the creeping speed to the maximum speed, and vice versa. To obtain this form of control in a hoisting direction, a simple rheostatic controller can be used. For lowering loads, however, it is necessary to equip the crane with some form of *mechanical load brake* or other form of dynamic braking control, for the tendency is to make the motor run away. Large, continuous running machines such as air compressors may be driven by synchronous motors. They should be installed where they will collect the least amount of dust. Industrial locomotives adapted to meet almost every kind of service are made in alternating or direct current trolley types. These machines usually are made to take direct current from one overhead trolley wire or alternating current from two trolleys. The storage battery locomotive is desirable where operating conditions do not permit the use of trolley wires and locomotives are to be used beneath craneways.

Sectionalized exhaust fan systems are the most economical. With this form of system the pressure required in different sections of the plant readily can be adjusted by varying the speeds of the relatively small driving motors. It is unnecessary to keep the entire system going simply to run one or two departments.

Centrifugal compressors have attained great efficiency and practicality within the last few years. They are used principally for cupola service, and owing to the absence of valves and rubbing surfaces there is no possibility for leakage and they maintain their initial efficiency indefinitely. Moreover, they are small in size for their output and run at high speed, thus permitting the use of direct-connected, high-speed drivers. Induction motor sets are arranged for constant speed and pressure and give entire satisfaction in cupola service. An actual capacity of 400 cubic feet of free air per minute generally is sufficient for each ton of iron melted per hour. The centrifugal type of compressor also may be applied advantageously to supplying combustion air for oil or gas-fired core ovens. The compact arrangement of a motor-driven compressor set also allows it to be located close to the oven, where it is economical in the amount of space occupied and directly under the

FIG. 4—TRANSFER CAR DRIVEN BY AN INDUCTION MOTOR IN THE RAW MATERIAL BAY OF THE ERIE WORKS OF THE GENERAL ELECTRIC CO.

FIG. 5—CENTRIFUGAL COMPRESSOR SET DRIVEN BY A 30-HORSEPOWER DIRECT-CURRENT MOTOR, WHICH FURNISHES THE BLAST FOR A 10-TON CUPOLA IN THE FOUNDRY OF THE SCHENECTADY WORKS OF THE GENERAL ELECTRIC CO.

eye of the core oven attendant. Outlet boxes should be located at convenient intervals in the foundry to permit the attaching of many small electric tools which may be moved about easily from place to place and are great time and labor savers. They include sand pulverizers, sifters, and jarring machines.

The possibilities of electrical applications along different lines is shown by the widespread use of electric furnaces, especially in the melting and refining of metal for high grade steel castings.

The Ogden Iron Works, Ogden, Utah, has been organized to take over the plant of the Western Foundry & Machine Co., in that city. Sugar mill and mining machinery will be built and additional property adjoining the works has been purchased with the intention of extending the plant. The officers of the new company are Joseph Scowcroft, president; Marriner Browning and R. B. Porter, vice presidents, and Lawrence T. Dee, secretary-treasurer. James W. Silver will be general manager.

Safety Meeting in Detroit

The next annual meeting of the National Safety Council will be held in Detroit, Oct. 17 to 20. The program contains the names of 140 speakers. The development of the council's work has indicated the need for intensive study of the problems of various industries, and at the coming meeting a number of conferences will be held dealing with special lines of industry involving the subject of safety. The foundry section, which will meet on Wednesday morning, Oct. 18, will be presided over by O. J. Fehling, manager, National Malleable Castings Co., Chicago; F. G. Bennett, safety department, Buckeye Steel Castings Co., Columbus, O., will be vice chairman and Earl B. Morgan, safety engineer, Norton Co., Worcester, Mass., will act as secretary. In addition to the reports of the chairman, secretary and special committees, the following addresses will be presented: "Strains, Sprains and Burns," by S. W. Ashe, educational and welfare department, General Electric Co., Pittsfield, Mass.; "Crane and Chain Practices," by F. H. Elam, manager, casualty department, American Steel Foundries Co., Chicago; "Eye Protection," by F. W. Shepard, safety inspector, American Cast Iron Pipe Co., Birmingham, Ala.; "Alcohol vs. Safety," by Dr. H. P. Hourigan, surgeon, Larkin Co., Buffalo; and "Foundry Sanitation," by J. F. Alexander, secretary, the Metal Trades Safety Association, Toronto, Ont. An exhibit of safety devices will be held in connection with the convention.

FIG. 6—SAND CUTTING MACHINE INSTALLED BY THE SAND MIXING MACHINE CO., NEW YORK, DRIVEN BY A DIRECT-CURRENT MOTOR IN THE FOUNDRY OF THE GENERAL ELECTRIC CO., SCHENECTADY, N. Y.

How to Reduce Your Loss From Foundry Fires

An Interesting Survey of the Causes of Fires in Casting Plants with Suggestions for Lowering the Cost of this Heavy Annual Wastage

By F H Wentworth

THE significance of the fire waste in this country is indicated by a report of the United States department of commerce and labor, which shows that the average annual per capita fire loss in six European countries is 33 cents, while the average per capita loss in the United States is $3, and in Canada $3.07. Glasgow has an annual fire loss of $325,000. Boston, smaller than Glasgow, has an annual fire loss of $2,000,000. Berlin has an average fire loss of $175,000 a year. Chicago, the same size, averages $5,000,000 annually. The Berlin fire department costs $300,000 a year; the Chicago fire department costs $3,000,000. These figures are sufficiently impressive, but they are not typical of these cities alone; they are typical of the entire United States and Canada as contrasted with Great Britain and the nations of Europe.

What is there in us, in our people, in our character, to explain this? What is the reason for this shameful contrast in the amount of property destroyed by fire? Is the explanation in a sense psychological? It is only within the last half dozen years that the United States has given any thought whatever to the conservation of its natural resources. We are now entering upon a new era, and a great deal of attention and thought is being given to this problem by men in all industries and especially by foundrymen. A special review of the fire records of foundries shows that besides the hazards common to all industries, foundries have certain special hazards peculiar to this particular industry. These are enumerated below with a brief comment on each.

Fire Hazards of Foundries

The principal hazard connected with preparing the mold is that of drying. This may be done with temporary stoves or furnaces placed directly in the mold, or with heat flues so arranged that the heat may be conducted to the interior surface of the mold, or by portable fuel oil torches or other similar means. In many cases excess moisture must be removed from the sand or else when the hot metal enters the mold it will form steam which, in expanding would endanger the mold and might even cause an explosion if there were a very large amount of moisture present. The fire record of foundries, however, does not show that this operation has been a source of any appreciable number of fires.

Core Ovens Present Fire Risk

Core ovens are usually constructed of brick and are heated by either hard coal fires, fuel oil or gas, whichever may be most convenient. The fire record shows that 15.3 per cent of foundry fires are traceable to the core oven. Nearly all of these fires could have been prevented by exercising a few simple precautions. Although woodwork has no place in a well-designed foundry, it is nevertheless found in a great many of them. Special effort should be made to remove any woodwork which may be near these core ovens or their flues. If this cannot be done, the woodwork should be completely covered with sheet metal or, better still, wire lath and plaster and Portland cement, or some asbestos covering. A flue or oven too hot to be touched by the hand is dangerous. Where the metal stack passes through the roof it should be protected by a metal thimble with an air space or some other equivalent, so as to prevent any possible heat from the flue igniting the wooden roof. Lumber or flasks should never be placed on top of core ovens. Care should be taken that core ovens are always kept in good repair and any cracks immediately filled with cement. Where possible, it is advisable to have the core ovens outside the building, having only the door opening into the foundry.

Records show that 42.7 per cent of foundry fires reported were caused by the cupola, a large part being started by flying sparks. The remedy for such fires is a simple one: (1) All roofs within possible range of sparks from the cupola should be covered with non-inflammable material; (2) the cupola should be equipped with a hood or other device which would prevent sparks from being showered over the neighboring roofs; (3) all unprotected inflammable material should be removed from proximity to the cupola walls. Where fireproof roofs are not used they should be covered with metal with no exposed wood ventilators, frames or skylights. Special precaution should be taken to prevent the roof igniting at the point where the cupola stack passes through it. Charging floors for cupolas should be of non-combustible material, such as iron, brick or concrete. There is considerable danger of fire when the cupola is dumped, and a hand hose should always be placed nearby for such emergency. The brass furnace does not present as serious a hazard as the iron furnace. It should not, however, be in proximity to woodwork, and never be used in rooms which do not have fireproof floors. At present, brass foundries are frequently found in other than one-story buildings with the foundry floor of combustible material.

Dangers of Pouring Metal

Before molten metal is allowed to run into the ladles it is necessary to remove the moisture from the ladle. This is usually done by kindling a small wood fire in it, although in some of the more modern foundries this is accomplished by the use of a large torch and a portable fuel oil tank outfit. In either case this does not present any appreciable hazard if carefully done in a clear space in the foundry. Very frequently when the castings are poured the hot iron ignites the wooden flasks. Such fires are readily extinguished generally by throwing sand on them. Again, the hot metal may be spilled on the floor or accidentally come in contact with combustible material if there should be any in the construction of the foundry. The advisability of keeping all combustible material out of foundry buildings is obvious. If this is done there is very small probability of a fire starting from the handling of hot metal. There have been one or two instances in which fires were caused by an explosion of the mold at the time of pouring. This may be considered an unusual incident, probably due to excessive moisture. Many fires have been caused from hot smouldering flasks. As soon as the sand and castings have been removed from the flasks they should

The author of this paper which was read at the annual meeting of the American Foundrymen's Association, Cleveland, Sept. 11 to 18, is secretary of the National Fire Protection Association.

be placed either in an outside yard, away from buildings, or at some point where there is no possibility of their igniting buildings in case a spark lingers in them to be fanned into flame. Special precaution should be taken that wooden flasks are never put in storage in a building until several hours have elapsed since their use, to absolutely insure the presence of no live sparks. Iron flasks do not present this hazard, and the only danger of fire from them which is quite remote, is when they are placed hot against some combustible wall. The general processes of cleaning the castings are practically free from fire danger. Projections and gates are removed from castings either by hand or compressed air power chippers. An acid bath sometimes is used to clean the castings and remove any clinging sand and slag. Care should be exercised in the storage of these acids, which are usually sulphuric or hydrofluoric. Tumbling is also a non-hazardous cleaning process accomplished by placing the castings in a slow revolving cylinder or receptacle where they become burnished by rubbing together. Coarse emery wheels are generally used to grind off projections and smooth up rough places. Emery wheel dust, if wet, may heat and ignite spontaneously. Burnishing, buffing and polishing are done with rag wheels. The principal hazards here are those due to hot bearings, spontaneous combustion, or sparks from the dust. A good collector system with metal blower pipes discharging into a fireproof receptacle is advisable. Lint should not be allowed to collect in the room and the receptacle should be frequently cleaned.

Many establishments which are primarily foundries carry on some other process in conjunction with the foundry work, and it is necessary to consider this feature in the proper study of the fire hazards of such a plant. Piping and pipe fittings are frequently dipped in asphaltum or tar to protect them from corrosion. This process should be carried on in a detached building, as fires have been caused by heating the pipes so hot that the tar was ignited when they were dipped into the bath. Painting, lacquering and japanning are other special processes which are occasionally found in connection with foundries. Their hazards will not be considered other than to advise that this work be carried on in a separate building particularly constructed for the purpose. The increasing use of fuel oil for heating core ovens and small portable torches for numerous other purposes has introduced an appreciable hazard into foundries. This material should be stored in an approved manner, and special precautions should be taken to see that all piping, tanks, etc., are maintained in good condition and free from leaks. It is advisable to have piping so arranged that in case of emergency the supply can be readily shut off at the source, and the piping drained.

It was at one time thought that automatic sprinklers were not suitable for use in foundries on account of the supposed danger of water being discharged on molten metal. Experience has shown, however, that this does not present any danger whatever and that automatic sprinklers can be used just as advantageously in foundries as in other properties. The fire record of foundries indicates that sprinklers have been very efficient when installed in such properties, and that if the system is properly laid out there is very small chance of a fire reaching serious proportions. Sprinklers are particularly effective in foundries because of the fact that a great many of the fires occur in the night after smouldering for several hours. These fires might not be discovered until they had made considerable headway. An automatic sprinkler system will promptly check any such fires and at the same time announce their discovery if an alarm system is included in the equipment. The accompanying fire record of the foundry industry is made up from the reports received by the association since October, 1906, and includes 475 fires in foundries making all kinds of castings, such as iron, steel, brass, etc. Although there is considerable difference in these materials and in the details of making castings from them, the essential processes and hazards are very much the same, and therefore it seems quite proper to include all kinds of foundries in the same fire record. One of the most interesting things brought out in the compilation of this record is that a large number of fires in foundries are caused by hazards not usually associated with such properties; that is, some other work on a small scale is carried on in the foundry in connection with the regular business. Two examples will illustrate this: (1) five fires were caused by dipping hot iron pipes (a product of the foundry) in asphaltum or tar in order to make them less liable to rust;

Fire Record of Foundries

Common Causes.

	No. of fires.	Per cent of common causes.	Per cent of known causes.
Heating	16	18.6	4.4
Lighting	12	14.0	3.3
Power	9	10.5	2.5
Lightning	4	4.6	1.1
Boiler (or fuel)	9	10.5	2.5
Oily material	5	5.8	1.4
Rubbish (or sweeping)	3	3.5	0.8
Locomotive sparks	19	22.1	5.1
Smoking	4	4.6	1.1
Miscellaneous	5	5.8	1.4
Total	86	100.0	...

Special Hazard Causes.

	No. of fires.	Per cent of special hazards.	Per cent of known causes.
Cupola	112	42.7	30.7
Sparks from	87		
Heat from	14		
Miscellaneous	11		
Core oven	40	15.3	11.0
Molding, pouring and casting	34	13.0	9.3
Furnaces	25	9.5	6.9
Hot castings	8	3.0	2.2
Slag	1	0.4	0.3
Flasks	7	2.7	1.9
Fuel oil	8	3.0	2.2
Dip tank	2	0.8	0.6
Charcoal	2	0.8	0.6
Asphaltum or tar dipping of pipes	5	1.9	1.4
Phosphorus	3	1.2	0.8
Miscellaneous	15	5.7	4.1
Total	262	100.0	
Common causes	86	23.6	...
Special hazard causes	262	72.0	
Incendiary	8	2.2	
Exposure	8	2.2	
Total known causes	364	100.0	
Unknown causes	111		
Total	475		

(2) in another large plant a fire started in a kitchen, which was part of the restaurant where the employes obtained their luncheon.

A study of the causes of foundry fires immediately brings out the fact that the cupola is still the most prolific cause, for 30.7 per cent of fires from known causes originated here, and nearly all these fires could have been prevented by such simple precautions as removing combustible material from the vicinity of the cupola, using only non-combustible roof coverings, and equipping the cupola with a hood or other device to prevent sparks from being showered over the neighborhood. Next to the cupola the core oven is the most frequent cause of fire. This hazard also could be almost entirely eliminated by giving careful attention to the construction of core ovens and their surroundings. Among the most frequent common causes are locomotive sparks and heating. The former is in part explained by the fact that many large plants have their own locomotives which enter various buildings, while the latter is no doubt largely due to the habit of constructing a rough office with a carelessly installed stove in the foundry proper for the use of the foreman or superintendent.

The record shows that 62.7 per cent of all foundry fires occurred at night, and for this reason they may smoulder for several hours unless a watchman is present to detect the fire. However, 32.9 per cent of all foundry fires were discovered by the watchman, which is a very good record. It is doubtful if there is any industry in which a watchman has better opportunities to prevent loss by fire than in a foundry, and consequently great care should be used to select a suitable man for this position. An examination of the record of automatic sprinklers in this class of property indicates that they have been very successful, for there were only 2.5 per cent classed as unsatisfactory and only 3.8 per cent of fires in buildings equipped with automatic sprinklers resulted in large losses.

It may be said that most of the fires in foundries can be prevented by the proper safeguarding of heating devices. Also, the use of combustible material should be avoided as far as practicable. If this is done and an automatic sprinkler system is installed, there should be very small chance of a serious fire.

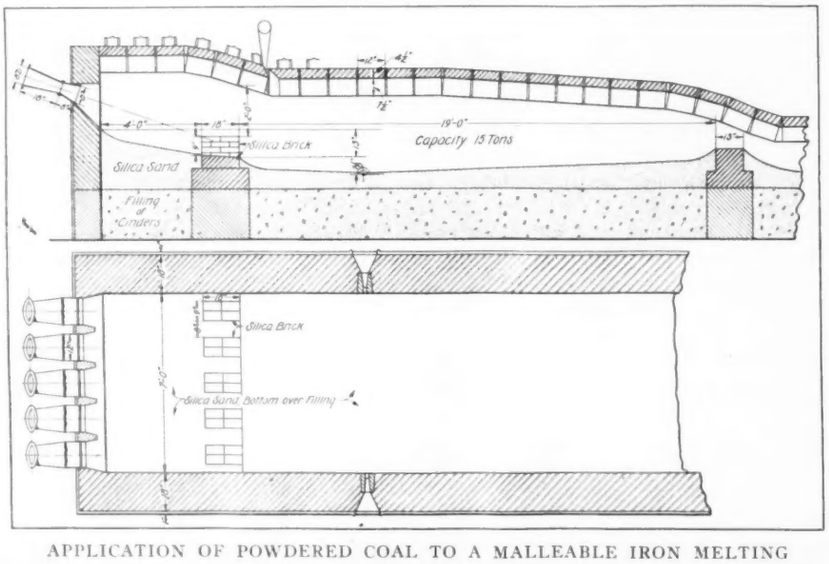
Powdered Coal as a Fuel in Malleable Shops---II

By Joseph Harrington

WHEN carbon is combined with enough oxygen to satisfy its demands, carbon dioxide, or, CO_2, is formed, and when atmospheric air is used to support combustion, a theoretical maximum of 20.7 per cent of CO_2 is obtainable. This is the same as the percentage by volume of oxygen in the air. In the complete burning of carbon in the form in which we usually know it, as coal, a considerable time element and mixing effect must be obtained in order to bring each particle of oxygen into contact with its carbon. In the average metallurgical furnace, and particularly in the average boiler furnace, this is difficult to secure. Mixing devices of various kinds have been employed to stir up the gases during combustion, so that the oxygen may be more completely utilized. With a layer of coal resting on a grate surface, the actual time during which any given particle of air is in direct contact with the fuel is extremely short, and if the fixed carbon alone is considered, combustion must take place close to the fuel bed, or not at all. With bituminous coals there is a considerable gaseous content, which is driven off by the heat of the furnace and burns in the fire box above the fuel bed, or in the combustion chamber. In a malleable melting furnace the fire box is nothing more than a gas producer. A deep fuel bed is carried, and the coal is largely gasified in the fire box proper. To obtain constant results as to the quality of the gases, uniform conditions of fuel bed and air pressure necessarily must be obtained. In hand firing, on the contrary, the character of the fuel bed is constantly changing, and with these changes the amount of air passing through also is changing. It is difficult, if not impossible, therefore, to maintain a given furnace condition for any considerable period.

In present practice there is a serious lack of mixing effect with the result that when the furnace is hot the flame frequently extends nearly, if not quite to the top of the stack. Every bit of heat generated, after the hearth is passed over, is lost. Under ideal conditions there must be no generation of heating beyond the hearth.

The addition of top air still further complicates the situation, because this is substantially constant in volume, and is in no way adjusted to the fluctuating requirements of the gas producing combination. Furthermore, the top air is introduced in a series of high pressure jets which bore holes in the gas and usually reach the pile of metal like a blowpipe flame. The temperature surrounding these jets, due to the presence of adequate oxygen, is very high. At the same time there is present an excess of oxygen which, when impingement on iron occurs, supplies all the elements for rapid burning of the



APPLICATION OF POWDERED COAL TO A MALLEABLE IRON MELTING FURNACE

iron. In sharp contrast to this, is the character of a powdered coal flame. The coal in this instance is ground to a degree of fineness which permits it to float in the carrying air forming a cloud-like formation of any density desired. With the pulverized coal diffused uniformly throughout the air current, each particle of coal is surrounded by a small volume of air which may be so proportioned as to be just the required amount for the proper combustion of the coal. When it is considered that the largest piece of coal is less than one-millionth of a cubic inch, it will be appreciated that the mixture of coal and air actually takes on the character of a gas, and, as a matter of fact, it actually burns in a manner similar to a gas flame. Owing to the independent control of the amount of both air and coal, any definite proportion of the two can be fed to the furnace, and variations in the proportions can be accomplished easily and definitely. Perfect uniformity, therefore, in the rate of supply can be had readily, and conditions of efficiency once obtained can be maintained definitely.

High Flame Temperatures

The temperature of the combustion of carbon in air is around 4800 degrees, and although it is not practical to obtain theoretically perfect conditions they can be much more nearly approached with powdered coal than in any other way. By restricting the amount of air supplied and getting complete combustion of the coal, no difficulty is encountered in obtaining flame temperatures of 3000 degrees. This is as much as anyone needs in melting iron, and is probably several hundred degrees in excess of the temperature actually obtained.

It is a well-known fact that the temperature of the flame is increased by just the amount that the air for combustion is preheated. If a given condition results in a 2500-degree furnace temperature with air at 60 degrees, about 3000 degrees can be obtained under similar conditions by heating the air to 500 degrees. It will be apparent from this that with a large amount of heat going up the stack of the malleable furnace, that it is entirely practical to obtain temperatures of any useable degree. The temperatures, moreover, may be varied at different stages of the process. If it is desired to hold a hearth full of molten iron, just enough temperature can be produced to keep it in the right condition without danger of either burning or chilling it.

Another and equally important result of the perfect control of air entering into the combustion process is the effect on the metal itself, from the standpoint of oxidation loss. As the temperature increases the tendency to oxidation also increases, so that it is doubly necessary to prevent the presence of excess oxygen when the metal is hot. It is a fortunate occurrence that this very condition obtains when powdered coal is used. With maximum temperatures there is a reduction in the excess oxygen. It is entirely possible to reduce this to a point where practical neutrality occurs. It is a matter of daily practice to secure combustion with not to exceed 2 per cent of excess oxygen, an amount so small that the effect on the metal is very slight.

A simple calculation will indicate the practical result of reducing the amount of oxidation by even 2 per cent. Consider a plant melting 60 tons of iron per day: Two per cent of this is 1.2 tons, which at $20 per ton amounts to $24 per day, or an annual saving of $7,200.

A practical check on the decreased amount of oxidation with the powdered coal flame is had in the billet heating furnace. The decrease in the scaling of the metal is so great as to be readily noticeable. In malleable practice we have not only to consider the actual iron loss, but the loss of such desirable elements as carbon and silicon which burn out of the iron at high temperatures in the presence of oxygen.

A section of a malleable furnace showing the powdered coal burners in position, is shown in the accompanying illustration. It will be noted that no attempt has been made to present details. The points to which particular attention are directed, are the locations of the burners in such a manner that the jets therefrom will strike directly upon the metal bath, and the location and inclination of the top air. This is so arranged as to form an air curtain supplying sufficient oxygen for completing the combustion, but at the same time at a sufficiently low velocity so that the air itself does not reach the metal. This is a detail which may be nicely adjusted, and when so operated fulfills all the requirements of combustion without the detrimental effects of metal oxidation. Both the velocity and the inclination of the fuel jets are adjustable, so that if desired, direct impingement on the metal may be obtained and the location of the point of maximum temperature can be controlled. In other words, the arrangement is one of scientific precision wherein the elements are under control and the results directly responsible to intelligent manipulation.

The American Locomotive Co. has placed an order with the Mathews Gravity Carrier Co., Ellwood City, Pa., for 15,000 feet of 8-inch heavy duty, roller conveyor, which is to be used for handling shell forgings at this company's large plant at Richmond, Va. The forgings will be forwarded from one department to another on gravity conveyor lines, which includes their receipt from incoming cars to their ultimate shipment. Another large order for 9,000 feet of 8-inch heavy duty, roller carrier to be used for the same purpose, was received from the E. W. Bliss Co., Brooklyn, N. Y. The order of the American Locomotive Co., as well as that of the Bliss company, involves roller carriers that will extend a total distance of 4 6/11 miles if all of the units were joined together in a straight line.

Chemistry in the Brass Foundry—V

(*Concluded from page* 436)

alcohol and dried for 15 or 20 minutes at a temperature of 220 degrees Fahr. After cooling in a desiccator the gauze may be weighed. Multiplying the weight of lead peroxide deposited, by 0.8643, will give the weight of lead actually present.

In the application of any of the foregoing methods to the estimation of the lead in an alloy, about one gram of the latter should be dissolved in a 6-ounce flask with 15 or 20 c.c. of nitric acid diluted with its own volume of water, heating until brown fumes stop coming off. If nitric acid alone does not completely decompose the alloy it may be necessary to add a few cubic centimeters of strong hydrochloric acid and heat until it is decomposed; 8 or 10 c.c of strong sulphuric acid next should be added and the solution heated over a flame until dense, white fumes come off, after which it may be cooled, diluted with 80 c. c. or so of distilled water and heated to boiling to dissolve any soluble sulphates of the other metals. The precipitate next should be filtered off and washed, first with dilute sulphuric acid, then with distilled water or alcohol, as previously directed. If the gravimetric method is to be followed the filter and precipitate, or Gooch crucible, should be treated as outlined.

When the volumetric method is to be employed the precipitate of lead sulphate is washed into a beaker by a jet of water and dissolved in ammonium acetate and, after making the solution slightly acid with acetic acid, titrated with standard ammonium molybdate solution.

In the electrolytic method, the lead sulphate is washed from the filter into a large beaker, then treated with ammonium hydroxide and finally is dissolved in nitric acid and the solution is electrolyzed.

THE FOUNDRY

A monthly journal devoted to all branches of the foundry trade

Published by

The Penton Publishing Co.

Penton Building, CLEVELAND

BRANCH OFFICES

BIRMINGHAM, ENG.	Prince's Chambers
CHICAGO	1521 Lytton Bldg.
CINCINNATI	404 Johnston Bldg.
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PITTSBURGH	2148-49 Oliver Bldg.
WASHINGTON, D. C.	206 Corcoran Bldg.

SUBSCRIPTION

United States and Mexico	$1.00 a year
Canada	$1.50 a year
Great Britain and other Foreign Countries	Eight Shillings
Single Copies	15 cents

Copies published three months or more previous to date of current issue, 25 cents each.

ADVERTISING

All communications relating to advertising copy, discontinuances, etc., must be received on the 10th of the month preceding date of publication.

ENTERED AT THE POST OFFICE AT CLEVELAND AS SECOND CLASS MATTER

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Three Theories Exploded

AS A RESULT of the allied foundry convention and exhibition in Cleveland last month at least three well-established theories regarding the attitude of American foundrymen toward their mutual welfare were exploded. Before the meeting, it was stated that the pressure of business was so great at the present time that it was useless to expect authors to take time to prepare papers of a high order of merit. But looking at the event in retrospect, and judging from the volume and character of the discussion, it is evident the authors of papers fully maintained the high standards set in previous years. It was also contended, previous to the convention, that everyone was so fully occupied with his own affairs that few would find time to get away and discuss common problems. The registration figures, totaling 1,257 for both associations, make it plain that such was not the case. It was further stated that manufacturers of foundry and shop equipment are so busy filling orders that there is no margin of time or energy remaining for the development of new and improved machines. The bewildering array of new ideas presented in the apparatus displayed at the exhibition staged in the Cleveland coliseum is in itself sufficient refutation of this latter contention.

But gratifying as the situation has proved itself to be, its principal significance lies in the fact, now clearly evident, that in the midst of an unparalleled rush for profits, the fundamental problems of the industry and of the future have not been forgotten. The European conception of American business as hypnotized by wealth and blind to the demands of posterity is false. Never was the necessity for the subordination of individual ambitions to the welfare of all more keenly appreciated than at present.

Tomorrow's Executives

MODERN foundries are turning more and more to technically trained young men for positions of responsibility. This was emphasized as never before during the recent convention of the American Foundrymen's Association, when the active part taken in discussions of all subjects by comparatively young men was unusually noticeable. The growing tendency in this direction is only another indication that the ranks of men from the old school of experience are fast thinning, and that to fill their places foundry owners are forced to turn to comparatively inexperienced, but ultimately capable graduates of technical institutions. The self-trained foundrymen have played an important part in the development of the industry, and it is only natural they are somewhat reluctant to grant the college-bred men a foot-hold in the casting business. The relations between the representatives of the old and the new schools, however, should be those of co-operation and friendship, for their best interests are mutual. Foundrymen who resent the newcomers, are those who do not appreciate the function of modern technical training. Manufacturers also will do well to co-operate with the technical institutions of the country, for in their efficiency lies the destiny of the executive personnel of tomorrow's foundries.

The labor situation in the casting industry has improved slightly during the past month. No. 2 foundry iron is quoted as follows: Pittsburgh, $19.70; Cleveland, $18.75; Chicago, $18.50; Philadelphia, $20.75, and Birmingham, $14.50

Death of A. T. Whiting

Alexander Talman Whiting, vice president and secretary of the Whiting Foundry Equipment Co., Harvey, Ill., died suddenly Sept. 12 at his home, 1347 North State street, Chicago. He was 64 years old.

Mr. Whiting was born at Sault Ste. Marie, Mich., and resided at Detroit for many years, removing to Chicago in 1893. With his brother, John Hill Whiting, he established the Whiting Foundry Equipment Co., which absorbed his activities the remainder of his life. Under the management of the brothers the business has been developed to large proportions and occupies a commanding position in the foundry world. Mr. Whiting was widely known and highly regarded. He was prominent in the Illinois Manufacturers' Association and the Chicago Association of Commerce. He is survived by his wife and three children, John Halman Whiting, Miss Elizabeth Whiting and Mrs. Charles Sommers Young.

Death of William Ferguson

William Ferguson, a well-known foundryman, for many years active in the Ferguson & Lange Foundry Co., Chicago, died suddenly Aug. 30 at his home in Chicago, of heart disease. He was born May 31, 1853, at Glasgow, Scotland, and at the age of six came to Canada with his parents. When 10 years old, he began work in a foundry to assist in supporting the family, continuing in that line of business until his death. After working in Hastings, Neb., Denver, Ottumwa, Ia., and other cities, he went to Chicago in 1888, and in 1898 founded the Ferguson & Lange Foundry Co., and continued active in its management until 1911, when he retired. Rest, however, did not suit his temperament, and in 1915 he resumed activity and continued his work until his death. During his years of retirement, he suffered a serious illness and this is believed to have been the cause of his sudden collapse. He is survived by his widow, three daughters and two sons. One son, Hugh D. Ferguson, of Chicago, is connected with the Ferguson & Lange Foundry Co.

Large Crane Orders

Wonham, Bates & Goode, Inc., 17 Battery Place, New York, eastern and export representatives of the Whiting Foundry Equipment Co., Harvey, Ill., and the Orton & Steinbrenner Co., Chicago, recently received a contract for nine Whiting electric and hand power traveling cranes from the New York board of water supply. These cranes will have an exceptionally long lift averaging approximately 100 feet and the span will be from 75 to 80 feet. The cranes are to be installed in various screen stations of the new water supply for the city of New York. Ten locomotive cranes, built by Orton & Steinbrenner have been sold to the French government. These will be stationed at the various ports on the Atlantic coast, principally Rouen and Dunkirk.

British Institute Meets

The annual autumn meeting of the Institute of Metals was held at London, Eng., Wednesday, Sept. 20. The following papers were presented: "The Allotropy of Silver", by Dr. W. D. Helderman; "Cadmium in Spelter", by W. R. Ingalls; "The Annealing of Arsenical Brass Containing 61 and 62.5 per cent of Copper", by C. H. Mathewson and E. M. Thalheimer and "The Development of the Spelter Industry", by E. A. Smith.

ALEXANDER TALMAN WHITING

Personal

John A. Rathbone, a foundryman of wide experience and the inventor of the multiple molding machine which bears his name, has been appointed instructor in foundry practice by the Pratt Institute, Brooklyn, N. Y.

Robert MacDonald, formerly president of the Associated Foundry Foremen, and manager of the plant of Samuel L. Moore & Sons Co., Elizabethport, N. J., has been appointed assistant general sales agent of the Lehigh Coke Co., South Bethlehem, Pa.

R. J. Collins, sales manager of the Cataract Refining & Mfg. Co., Buffalo, died at his home in that city on Thursday, July 20.

Master Pattern Makers Organize

The formation of the Master Patternmakers' Association during the American Foundrymen's Association convention which was held in Cleveland Sept. 11 to Sept. 15, marks an interesting development in that branch of the foundry industry. The men originating the idea felt that the relation between the foundry foreman and the pattern shop foreman might be more nearly equalized, and that technical papers of interest might be presented each year. To perfect the organization, a dinner was held Sept. 14 at the Statler hotel. Those attending the first gathering included J. H. Taylor, superintendent of pattern shop, Fore River Ship Building Co., Quincy, Mass.; F. E. Delano, superintendent of pattern shop, Erie, Pa., works, General Electric Co.; John Pemberton, superintendent of pattern shop, Lynn, Mass., works, General Electric Co.; John O. Howarth, superintendent of pattern shop, Westinghouse Electric & Mfg. Co., Cleveland; R. I. Clegg, Gardner Printing Co., Cleveland; Alexander Crowe, superintendent of pattern shop, Youngstown Sheet & Tube Co., Youngstown, O.; George Hogg, Oak street plant, United Engineering & Foundry Co., Youngstown, O.; C. D. Morris, manager, United Engineering & Foundry Co., Youngstown, O.; Ira Cole, plant superintendent, American Road Machinery Co., Delphos, O.; A. S. Hamman, foundry foreman, American Road Machinery Co., Delphos, O.; S. A. S. Wormsted, superintendent of pattern shop, Goulds Mfg. Co., Seneca Falls, N. Y.; E. C. Anderson, assistant to president, Thomas E. Coale Lumber Co., Philadelphia; A. W. Anderson, salesman, Thomas E. Coale Lumber Co., Philadelphia, and J. F. Shea, superintendent, Lake Torpedo Boat Co., Bridgeport, Conn.

It is the plan of the organization to meet in conjunction with the annual conventions of the American Foundrymen's Association. While no officers were elected at the first meeting, plans were made to convene again next year at the American Foundrymen's Association convention and to consider plans which a committee will submit at that time.

Issues Booklet

An eight-page booklet entitled "Development" has been published by Day & Zimmerman, constructing and operating engineers and architects, Philadelphia. It contains an interesting article entitled "Industrial Indigestion", as well as illustrations and brief descriptions of several of the plants recently built under the supervision of this company.

WHAT THE FOUNDRIES ARE DOING

Activities of the Iron, Steel and Brass Shops

The Racine Foundry Co., Racine, Wis., has changed its name to the Simms Foundry Co.

The Doty Foundry, Goderich, Ont., Can., will be reopened after having been closed for some time.

The Adamant Iron & Steel Co. has purchased the plant of the Cleveland Steel Valve Co., Kent, O. A steel foundry will be operated.

The Pockett Foundry & Machine Co., Hattiesburg, Miss., has been incorporated with a capital stock of $10,000 by N. W. Pockett, D. L. Dwiney and R. W. Sharp.

The Schwartz Foundry Co., Detroit, has been incorporated with 75,000 capital by Frank L. Schwartz, Frank L. Schwartz Jr. and Elmer H. Schwartz.

The foundry business of O. V. Hooker & Son, St. Johnsbury, Vt., has been purchased by Louis N. Smythe, Alexander Dunnett and Perley F. Hazen, who will incorporate.

The Union Tool & Die Co., Indianapolis, Ind., has been incorporated with $10,000 capital to engage in the manufacture of dies, castings and machinery. The incorporators are Dunward Rivers, C. J. McHugh and E. W. Holt.

The L. & S. Foundry Machine Co., Manhattan, New York City, has been incorporated with $2,000,000 capital to engage in the manufacture of motors, engines, machines and manufacturers', builders' and mill supplies The incorporators are L. Slater, 909 Jackson avenue; J. L. Sullivan, Marlborough hotel, and G. N. Campbell, 47 West Thirty-fourth street, New York City.

New Construction

Cureton & Son, Lexington, O., will rebuild its foundry recently burned.

Thomas Urey, Mercer, Pa., will build a jobbing foundry.

The Electric Steel Castings Co., West Allis, Wis., will build a foundry.

The City Iron Foundry Co., Lowell, Mass., is erecting an addition to its plant, 80 x 80 feet.

La Fonderie de Thetford Cie, Ltd., Thetford Mines, Que., Can., will rebuild its foundry which was damaged by fire.

A contract has been let for erecting a one-story foundry for the Kedzie Foundry Co., Chicago.

The Calumet & Hecla Mining Co., Calumet, Mich., contemplates erecting an addition to its foundry.

The Connecticut Electric Steel Co., Inc., 50 Church street, New York City, will erect a $15,000 foundry at Hartford, Conn.

The Adams Truck, Foundry & Machine Co., Findlay, O., contemplates building additions to its plant.

Oscar Baun, Chicago, will erect a one-story, 40 x 200-foot foundry to cost approximately $10,000.

The Canadian Hanson & Van Winkle Co., Ltd., Toronto, Ont., is building a $7,500 addition to its foundry.

The foundry of Marcoux & Porier, Beauceville, Que., Can., recently damaged by fire, will be rebuilt and new machinery installed.

The Augmore Mfg. Co., Cleveland, manufacturer of water heaters, will erect a one-story foundry at a cost of $5,000.

The Robert Rom Co., Milwaukee, will erect a foundry at Sixty-third avenue and Papham street, West Allis, Wis.

The Massachusetts Machine Co., Boston, will erect a one-story, 180 x 400-foot plant, which will include a foundry.

The National Bronze & Aluminum Foundry Co., Cleveland, will erect a $15,000 addition to its plant.

The Western Tool Mfg. Co., Springfield, O., contemplates erecting an addition to its foundry.

A contract has been awarded by the Gorham Mfg. Co., Providence, R. I., for a one-story, 65 x 122-foot brick building and a one-story addition to its foundry.

The American Brake Shoe & Foundry Co., New York City, will establish a foundry at St. Thomas, Ont., Can. The building will be 50 x 225 feet.

The Universal Winding Co., Providence, R. I., will build a brick and steel foundry to cost $40,000 and a wood and steel storehouse.

Bids are being received by Schenk & Williams, architects, Dayton, O., for erecting a foundry addition, 40 x 75 feet, for the Computing Scales Co., that city.

The foundry of the Osage Foundry & Machine Co., Bartlesville, Okla., recently damaged by fire, will be rebuilt and approximately $10,000 will be expended for machinery to re-equip the plant.

NEW TRADE PUBLICATIONS

FUEL OIL APPLIANCES. — A 28-page bulletin devoted to the extensive line of fuel oil appliances manufactured by the W. S. Rockwell Co., 50 Church street, New York, recently has been issued. Oil burners and their applications are illustrated and described in detail, as well as fuel pumps, blowers, valves, oil pressure tanks, steam separators, steam blowers, etc.

MOTORS.—Induction motors for two or three-phase alternating current are illustrated and described in a 52-page catalog issued by the Lincoln Electric Co., Cleveland. The unique rotor construction of this motor is described in detail and the installation of the stator between phases also is considered. Motors for elevators and hoists, pump motors, etc., are shown and many views of applications of this line of motors are included. One section shows the installation of this line of motors in metal-working plants. The arc welders built by this company also are briefly considered.

MULTIBLADE FANS.—A 24-page catalog has been issued by the Clarage Fan Co., Kalamazoo, Mich., which illustrates and describes its line of multiblade fans adapted for heating or ventilating installations in factories, mines, tunnels, public buildings, etc., for furnishing blast for cupolas and various other applications. A large number of capacity tables are included, which are made up from actual performance tests and these are guaranteed to be correct for standard conditions with air at 70 degrees Fahr. and barometric pressure at 29.92 inches. Dimension tables also are included and exhaust fans, speed exhausters, volume blowers, pressure blowers, etc., also are illustrated and described.

FLEXIBLE SHAFTING, ELECTRIC TOOLS AND MOTORS. — Three bulletins devoted respectively, to flexible shafting, electric tools and electric motors have been issued by the Stow Mfg. Co., Binghamton, N. Y. The bulletin devoted to flexible shafting contains 58 pages and illustrates and describes this equipment in detail and shows its many applications in industrial plants. The bulletin devoted to electric tools, describes electrically-driven drills, buffers and grinders, screw drivers, post grinders, bench and floor grinders, etc. The electric motor bulletin contains 20 pages and shows the 4-pole multi-speed motor of the stationary type, bi-polar multi-speed motor, small power motors, etc., built by this company.

FOUNDRY SUPPLIES.—A comprehensive 352-page catalog, devoted to foundry supplies and equipment, has been issued by the Hill-Brunner Foundry Supply Co., Cincinnati. The introduction to this work is unique inasmuch as it contains numerous notable quotations and the suggestions will prove of value to foundrymen generally. The first section of this catalog is devoted to facings of various kinds with instructions for their application. This is followed by a section devoted to iron filler cements, ferro alloys of various kinds, and foundry sands are next considered. Succeeding sections are devoted to brushes, riddles, shovels, wheelbarrows, chaplets, bellows, mallets, flasks and trimmings, pattern letters, patternmakers' equipment, core compounds, wire cutters, core room equipment, molding machines and accessories, etc. Practically 200 pages are devoted to equipment for the brass, gray and malleable iron and steel foundry. The catalog is unusually complete, is well-illustrated and well-arranged. Sixteen pages are devoted to helpful suggestions for foundrymen, including an explanation of the elements in iron, methods of making mixtures, data regarding coke, chemical compositions of castings for various purposes, weights and measures, terms applied to electrical units, etc.